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CATALOGUE  
OF THE  
WESTERN SCOTTISH FOSSILS.

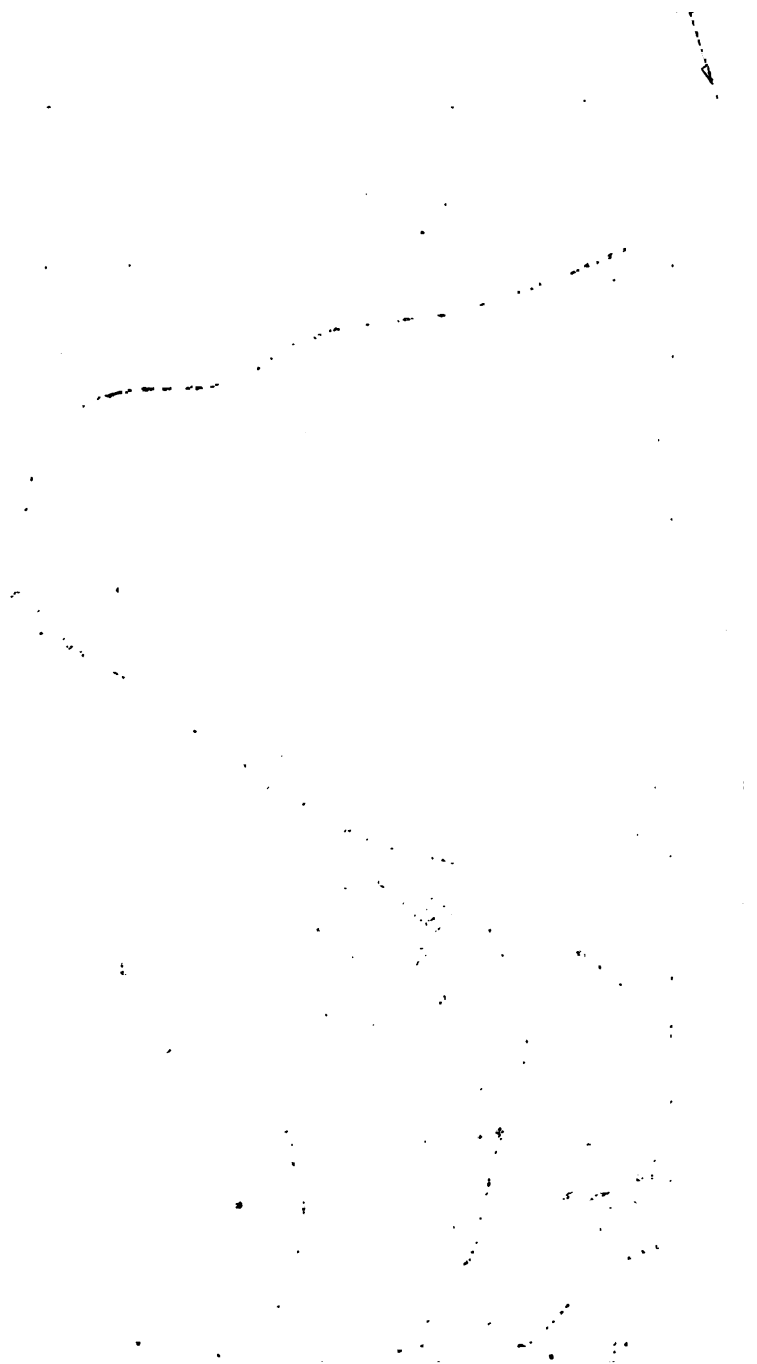
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CATALOGUE  
OF THE  
WESTERN SCOTTISH FOSSILS.

COMPILED BY  
JAMES ARMSTRONG, JOHN YOUNG, F.G.S.,  
AND DAVID ROBERTSON, F.G.S.

WITH INTRODUCTION  
ON  
THE GEOLOGY AND PALAEONTOLOGY OF THE DISTRICT,  
BY PROFESSOR YOUNG, M.D.



GLASGOW:  
BLACKIE & SON, 17 STANHOPE STREET.  
1876.

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## P R E F A C E.

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The nucleus of this volume is the Catalogue of Carboniferous Fossils of the West of Scotland prepared by Messrs. Young & Armstrong, and published in 1871 by the Geological Society of Glasgow. That list has been brought down to the present time, and the geology of the vaguely designated "West of Scotland" completely represented by newly prepared lists of the fossils obtained from all the deposits from the Silurian to the Glacial included. No one who has not tried it knows the labour such lists involve, but those who have tried it can estimate the continuous labour which Mr. Armstrong has bestowed on the work, and the care with which Mr. Young and he have revised the proof-sheets,—itself no light task. Mr. Young prepared the preliminary sketches of the Old Red, Carboniferous, and Permian formations, and notes on the distribution of the Carboniferous fossils. Mr. David Robertson has supplied a great want by his complete list of Glacial fossils.

Mr. Charles Lapworth has, with his wonted kindness, and even more than his wonted energetic enthusiasm, written the summary of Silurian stratigraphy, and enhanced the value of the volume by the four beautiful plates of Graptolites. Mr. Dairon supplied important information regarding the Moffat district.

Messrs. Armstrong & Young desire to acknowledge the readiness with which their friends undertook every trouble by which the work of compilation might be lightened, and fulness and accuracy secured.

Mrs. Robert Gray has given a list of the Silurian fossils in her cabinet. Dr. Slimon has revised the lists of Lesmahagow fossils, and corrected the localities for that classical district. Dr. Rankin of Carlisle, Dr. Grosart of Shotts, Mr. John Smith of Eglinton Iron Works, Kilwinning, Mr. R. Craig, Langside, Beith, Mr. James Linn, Livingstone, Mr. A. Patton, East Kilbride, and Mr. James Bennie, H.M. Geological Survey, have given much valuable information as to Carboniferous localities, and as to the occurrence of species at various horizons. Mr. James Thomson and Mr. R. Ether-

idge jun., were kind enough to diminish the labour of reference by sending copies of their published papers.

Dr. J. Bryce, LL.D., wrote the notice of the Jurassic Strata of Skye and Raasay, the list of fossils being prepared by Mr. Armstrong from the published papers referred to in that section. The Mull species are the determinations of Mr. T. Davidson, F.R.S., and Mr. Etheridge, F.R.S.

Mr. Davidson corrected the lists of Brachiopoda, Professor Rupert Jones those of the Ostracoda, and the Rev. A. M. Norman those of the Post-Tertiary Polyzoa. Professor John Morris has likewise given special help. To these gentlemen Glasgow geologists are under obligations, not for the first time.

Mr. D. C. Glen and Mr. J. Young, jun. have made a list of the Western Minerals and Rock specimens from the Hunterian collections, and from published papers and catalogues.

The Introduction is an attempt to translate into history the geological details of the district. The discussion is by no means exhaustive, neither are the views it contains likely to receive general acceptance. But the object of the writer will have been gained if the visitor finds it easier with the help of this Introduction to realise the relations of the strata in a general way, and if resident students of Geology are induced to methodise their knowledge for the purpose of refuting the errors of the author.

The Local Executive Committee of the British Association deserve the thanks of all students of science for the wise liberality with which they have entered on this publication, and thus secured what private means could not have easily accomplished—a record of Scottish Geology and Palæontology, which will be a permanent memorial of the meeting of 1876.

JOHN YOUNG, M.D.

GLASGOW UNIVERSITY, *August*, 1876.

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## THE GEOLOGY AND PALAEOLOGY OF THE WEST OF SCOTLAND.

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THE geological history of Scotland strikingly recalls that of Northern America. In both countries the Laurentians or fundamental gneiss form the basis of the stratified series; but while in America younger strata flank the northern face of the Laurentian mass, in Scotland the narrow band of fundamental gneiss forming the backbone of the Hebrides sinks abruptly into the Atlantic Ocean. On Geikie's map are shown the areas in which the fundamental gneiss has been recognized, but it is uncertain whether patches elsewhere may not yet be referred to this group of highly altered strata. Sir R. Murchison adopted Sir W. Logan's term Laurentian gneiss in place of fundamental gneiss, believing that these earliest stratified rocks were synchronous in time, as they are similar in composition, and in discordance with superimposed strata. The adoption of the American group-name has been objected to both because the Scottish gneiss has not up to the present time yielded any fossils on which a comparison might be founded, and because there is, in defect of other evidence, no proof that the metamorphic series in America and Scotland may not be of different dates, though homotaxially their relations are similar. The negative evidence—the want of fossils—cannot have a positive value assigned to it; and the second objection is equally without positive value. It has been suggested elsewhere that the existence of pre-Laurentian stratified deposits is an assumption; and it is noteworthy that wherever the Laurentian rocks or their equivalents have been found they are subordinated to strata whose analogy to Huronians or Cambrians is generally accepted. In other words, the general parallelism of succeeding deposits is admitted, and a broad margin is asked for only in the case of these earliest rocks. The Scottish Cambrian series is very simple in its character as it is limited in its extent. The red and purple sandstones and conglomerates of which it is composed are such deposits as, according to Professor Ramsay's views, might have been accumulated during a continental condition of things in Northern Scotland, while in Western England the

continental merged into the marine conditions of the Upper Cambrian deposits. The comparatively unchanged sandstones contrast strongly with the altered strata above and below as well as with their extremely metamorphic equivalents in Wales. The entire absence of fossils (for worm tracks, though they prove life to have existed, give no help in identification of beds) furnishes an interesting analogue of the relations of the Old Red Sandstone to the Devonian, of continental to marine strata. The Laurentio-Cambrian land had probably its chief extent Atlantic-wards, and dipped to a coast-line whose northern limit lay somewhere across the Irish Sea. It is frequently stated that this land lay to the east; but during the deposition of the Silurians it could not have occupied that position, and inspection of the geological map shows a regular increase of land from the north-west towards the south-east, just as in America the land gradually widened from its Laurentian axis.

The Silurian series presents in Scotland some noteworthy differences from that in Wales. Consisting, in the area north of the Forth and Clyde, of metamorphic rocks having a north-easterly trend, there is as yet no grouping of the strata possible save a rough mineralogical one in which bands of quartzites separate schists, while the patches of altered limestone show the lenticular form characteristic of Silurian calcareous rocks, but from their infrequency give little help towards the tracing of definite horizons. Between Cape Wrath and the Clyde there are doubtless many foldings, by which the same strata are brought again and again to the surface, but in only one locality, Durness, have fossils been hitherto found, and these, few in number, are undoubtedly Lower Silurian, albeit they are of American aspect. Resting unconformably on the Cambrians, unconformably covered by, where not faulted against, the Old Red Sandstone, the North Highland Silurians form only a single series, so far as we know. The amount of metamorphism varies; in places, as on the Argyleshire shores of the Clyde, grauwackes may be found still retaining traces of their original condition, while not far off compact quartzites are as homogeneous as if they had never been granular. The flaggy shales may have undergone a slight amount of cleavage, as on the shores of Loch Lomond; or have undergone a very great amount, as at Ballachullish; but even these are not so perfect slates lithologically as those of North Wales. In the extreme north a higher degree of general metamorphism is seen, and it is only there that resemblance can be detected between Silurians and Laurentians, the two being known in Murchison's earlier papers as the younger and the older gneiss respectively. The southern margin of the Highland Silurians is formed by the Grampians, on whose flanks rest the heavy conglomerates of Old Red Sandstone age. On the southern side of the middle valley the Silurians form the broad band which is bounded by a line stretching from Girvan to St. Abb's Head on the north, and by the Solway on the south. The ridge has its greatest height between Merrick

(2764 feet), on the borders of Kirkcudbright, and Broad Law (2754 feet) in Peeblesshire. Southwestwards it slowly sinks till it disappears beneath the Carboniferous rocks in Connaught; at its north-eastern end it is covered with violent unconformity by the Upper Old Red and Carboniferous, these deposits holding similar relations to it in Liddesdale and Solway, as also in Haddington and Mid-Lothian, but they are separated in Lanarkshire by the interposition of the Lower Old Red Sandstone. The main anticlinal axis of this region passes through Eskdalemuir, nearer to the southern than the northern margin of the tract. Either there has been a difference in the amount of elevation to north and south or the denudation on the southern side has been greater; in any case there is a greater exposure of Silurians to the north of the axis, the younger deposits approaching it more closely. The Geological Survey has divided the main mass of the Lower Silurians, partly by lithological characters, partly by help of certain fossiliferous bands, and Mr. Lapworth has adopted a similar mode of division, though his correlations may not meet with general acceptance. This much seems certain, that while the axial beds are Llandeilo, the Caradocs are represented towards the margin of the tract in the Leadhills and Girvan districts, while the Llandovery series covers the Caradocs in the last-mentioned area. The fossiliferous strata are curiously localized, and the assemblages present certain important differences from those of the English Silurian series, especially in the number of peculiar species, and, as Salter noticed, of American forms. Unconformably on these Lower Silurians repose, on the north side at the Pentland Hills and Lesmahagow, on the south side at Riccarton and Balmae Head, representatives of the Upper Silurians of Ludlow and Wenlock age. Scotland, then, during Silurian times, seems to have been under water, in which were deposited the sediments of western and north-western lands. The sea was apparently deeper towards the south-west, but the subsidence was less than in the Welsh area; at all events, a difference of conditions is suggested by the dissimilarity of the fossils. While a part of the English series was being deposited re-emergence had taken place, and on the bank thus raised were deposited patches of the Upper Silurian series. The mixture of fossils in these patches permits only a general reference of the beds to the Ludlow and Wenlock groups, even the Girvan Lower Llandovery containing Upper Silurian forms. These important physical changes seem to have been unaccompanied by volcanic phenomena in the Scottish area, though in Cumberland, Wales, and South-eastern Ireland such phenomena are distinctly traceable. A portion of the Silurian rocks exposed in the coast section south of Girvan were formerly described as trappean; but Mr. J. Geikie has shown that this interesting series gives in reality a peep into the process of metamorphism, since the sandy rocks can be traced into felspathic representatives, the calcareous into serpentines. The whole tract, thus exhibiting many phases of metamor-



phism, justifies the following conclusions: 1, that the process of metamorphism is not in all cases one of igneous fusion, for the successive strata are unequally affected; 2, that alteration by hydrothermal agency does not necessarily require great depth for its completion, since there is no proof that this area was ever covered by any great thickness of younger strata; 3, that much plication or squeezing of the strata altered is not invariably present. In the south of Scotland, in Arran, and amongst the highly altered Highland Silurians, granitic masses are frequent, and have furnished ample material for the still unsettled discussion as to the igneous or hydrothermal origin of the rock. Bearing in mind that the Girvan metamorphics contain rocks indistinguishable from volcanic felstones, there is no reason to doubt that granite may likewise have a double origin. The granite of Arran, in the mode of occurrence of the coarser and of the finer grained varieties, seems to present an instance of hydrothermal origin; while Mr. Judd finds volcanic granites in the Western Islands.

The relations of the Old Red Sandstone and Carboniferous rocks show that the Silurians had, subsequent to their alteration, undergone extensive denudation. Both in North and South Scotland the plains of marine denudation are distinct on true sections, while Professor Geikie has admirably shown the relations to the axes of elevation of the longitudinal and transverse valleys. Between the Grampians and the Southern Highlands the wide hollow was perhaps occupied by Lower Old Red Sandstone, beds of which skirt the Grampians and spread over Perthshire as far as the Ochils, while on the south the Upper Silurians of the Pentlands and Lesmahagow graduate upwards into Lower Old Red. Towards the west the Grampian band narrows till it runs out at the mouth of Loch Long; on the east coast it spreads out from Stonehaven to the south shore of the Tay estuary. It probably extended seawards so as to become continuous with the beds which margin the Moray Firth, and spreading out over Caithness extend to the northern islands, where the formation is being examined by Professor Geikie. From this northern series the Kincardineshire sandstones are now separated by the Aberdeenshire coast line. Frequent undulations in Perthshire give repeated exposures of the contemporaneous lavas and ashes which were associated with the earlier strata, and the same phenomena are repeated in the Pentland and Lesmahagow districts and in the Heads of Ayr. The fossils of the Lower series are few; *Pterichthys major*, *Cephalaspis*, *Beyrichia*, *Dithyrocaris striata*, *Orthoceras dimidiatum*, *Spirorbis Lewisii*, and a graptolite fragment, the last five being from the Tulloch beds and their Lanarkshire representatives, the first from the Heads of Ayr; the whole showing transition from Silurian to Old Red Sandstone of a similar kind to that already seen in the groups of strata below. The discovery by officers of the survey of plant remains doubtfully referred to the lycopod genus *Psilophyton*

scarcely contributes to our knowledge of the circumstances under which the strata were laid down. The remarkable absence of shales such as abound above and below is especially noteworthy. The argillo-siliceous flagstones of Caithness, partly sand and partly clay, and "bound" with bituminous matter, have no equivalents in the south, nor has the abundant and varied fish fauna which the flagstones contain. An unconformity of an upper volcanic series on that lower series which graduates downwards into the Silurians has been noticed by Professor Geikie as recognizable in the Pentlands and around Tinto, but as dying out to the south-west, its place being perhaps marked by the heavy conglomerates of the Leamahagow district.

The Upper Old Red Sandstone of Scotland, south of the Tay, is unconformable to the Lower, while it graduates into the Calciferous Sandstones which cover it. If it is regarded as the base of the Carboniferous series, as Salter thought it to be, then the Upper Old Red is not represented in the west, what was taken for it being only the red sandstones of the Calciferous series. The earliest Carboniferous rocks, then, present two types within the area of Lanarkshire, for the Mid and West Lothian series of dark shales with sandstones and limestones, the shales being oil yielding, dies out towards Auchengray, and its place is taken by the strata which are characteristic of the west and of the extreme east of Scotland. These form a variegated series, often thin bedded, of fresh-water, doubtfully of estuarine, origin. The limestones are impure, earthy, or concretionary in South Lanarkshire and Western Renfrewshire; fine grained, magnesian, in the Campsie and Dumbarton districts. The remains of animal life are few, and the coal seams of the oil-shale series of Linlithgow are represented by only scanty fragments of vegetables. The sections on the Campsie Hills at Ballagan, Finglen, and Spital Glen, and in the Leven Valley at Auchenroch, display this Ballagan series very satisfactorily, and show the relation of superposition to the red sandstones. If these beds are the counterpart of the series found in the Merse, the state of matters in Western Renfrewshire and Stirlingshire is comparable with that in Haddingtonshire. Following the Ballagan series from the Campsie Hills into the Kilpatrick Hills, and thence to the high grounds south of the Clyde, the sedimentary strata are largely replaced by volcanic products. In the Campsie Hills numerous sheets of trap rock cover the series; in North Ayrshire these traps thicken and extinguish the sedimentary strata. In the Kilpatrick Hills strata containing coal plants have been found, but seldom in such mass as in connection with the coal seam at Glenarbuck, above Bowling. The early history of the Carboniferous series is thus one of original variety of surface, and of subsequent irregularity of movement. The lacustrine aspect of the Merse and Ballagan series, the estuarine conditions suggested by the Mid-Lothian type, tell of variety of surface, while the greater

thickness of the group in the east of Scotland speaks of unequal subsidence. This inequality is further testified, even in East Lothian, by the manner in which the Calcareous series thins away westwards towards the Silurian Hills of the Moorfoots. The high grounds to these lakes and estuaries were the Silurian hills and the Old Red Sandstone masses of the Pentlands and Lesmahagow, while to the north the land probably shelved away to the Grampians, the Calcareous series not reaching to the Silurian rampart.

Further subsidence finally brought the central valley beneath the sea of the Carboniferous Limestone. The floor of that sea was rendered uneven by masses of volcanic material, such as the North Ayrshire bank, while many craters scattered over the region poured out lava and ashes even during the period of subsidence. Before the close of this stage the promontories of the Old Red and Silurian were covered, and as the limestones crept over the sinking land they came to repose at last on the Old Red itself, as in the Douglas basin. The Carboniferous Limestone presents important local variations both in its physical characters and fossil contents. In the Dalry coal-field the strata of the Lower Coal and Ironstone series are largely replaced by volcanic materials. In the Ayrshire coal-field the Limestone all but disappears, the Coal Measures coming in contact with the Calcareous Sandstones. Following the Carboniferous strata across the North Channel, Bute, Arran, and Cantyre being the stepping-stones, we find the Ballycastle coal-field identified by Professor Hull with the Carboniferous Limestone of the Scottish type, viz. a mass of red sandstones and conglomerates corresponding to the Calcareous series, and resting on the metamorphic rocks. From the east of Scotland to Derry we have a distinct area whose limestone group contrasts with that of England and South and Central Ireland. The limestone beds are thinner, the sedimentary beds are thicker, as Professor Hull showed. The marine deposits are separated by estuarine or fresh-water deposits, while the presence of coal seams tells of the existence of land at such spots or at least of very shallow water close to land. But the most remarkable feature in such comparison of the Carboniferous Limestone strata of Central and Western Scotland is the presence of what are called at page 32 *post* Lower Coals and Ironstones. Between the Upper and Lower Limestones we have here a series of strata, which, in the absence of the Upper Limestone, would almost pass for the true Coal Measures, so closely similar are they in structure and fossils. There was not slow, general subsidence, but oscillation, whereby land was again and again exposed, while during one considerable period the sea was excluded by changes in the geography of adjacent districts, possibly by unequal elevation of land towards the west.

The absence of all sign of oscillation in the English area, even in Northumberland, proves the entire distinctness of the Scottish formations, and seems to forbid the supposition that the Carboniferous

Limestone Sea had been a continuous one from the Grampians to the Midland counties; and to point to the existence of a barrier in the position of the southern uplands. The English Limestone series was in all probability contemporaneous with, not the so-named series in Scotland, but with all the deposits from the Upper Old Red, and perhaps part even of that. If this is so, then a difficulty arises in the way of Professor Hull's general rule that limestones imply deep water. For if the Scottish area were so narrow as assumed, and, moreover, narrowed westwards towards Ireland, we should not expect thick limestones nor pure ones. The cement limestones, it is true, are impure, but in the lower series the beds at Beith attain a thickness of 40 feet, and the marine fauna is neither scanty nor dwarfed. The sedimentary and calcareous rocks then in England and Scotland, in Central Ireland and North Ireland, do not replace each other gradually; the difference is abrupt, the separation being abrupt. Comparison of the Lanark, Dublin, and Limerick Limestone series as regards fossils shows the water shallowing northward, the pelagic forms being most numerous in Limerick. As between the Clydesdale and Dublin Carboniferous basins the difference is greatest in species, and is in that respect unexpectedly great. It is, in fact, such as can be explained only by the isolation or nearly complete separation from each other of the two areas.

The following table shows the distribution of the strata of organic and of mechanical origin in the three divisions of the Lanarkshire Carboniferous Limestone in the Carlisle district and in the isolated Douglas basin.

		Fms.	Ft.	In.	Fms.	Ft.	In.	Fms.	Ft.	In.
UPPER GROUP.	Limestone, 3 beds, .	0	12	6						
	Coals, 1 bed, .				0	2	0			
	Intermediate Strata (3 series), .							48	3	7
MIDDLE GROUP.	Coals, 5 beds, .				0	8	0			
	Intermediate Strata (4 series), .							26	4	2
	Limestone, 15 beds, .	5	3	11						
LOWER GROUP.	Coals, .				0	3	0			
	Intermediate Strata (15 series), .							86	5	7
	Calcareous Sandstone Series.									
<hr/>										
		7	4	5	2	1	0	162	1	4
					7	4	5		2	1
									7	4
					9	5	5			5
								172	0	9

Thus, out of a total thickness of 1032 feet, limestone only occupies 46 feet, coal 13 feet: the proportion of organic strata to those of inorganic origin is therefore 59 : 973 or nearly 1 to 16.

The following is the analysis of the Douglas coal-field (*Survey Section, Explanation: Lanarkshire, p. 32*):—

		Fms. Ft. In.	Fms. Ft. In.	Fms. Ft. In.
UPPER.	{ Limestone, 1 bed, .	0 5 0		
	{ Strata (2 series), .			36 0 0
MIDDLE.	{ Coal, 10 seams, .		6 1 10	
	{ Ironstone, clay-band, .		2 0 6½	
	{ Strata, .			41 0 0
LOWER.	{ Limestone, 3 beds, .	5 1 4		
	{ Strata, .			4 1 5
		6 0 4	8 2 4½	81 1 5
			6 0 4	8 2 4½
				6 0 4
		14 2 8½		95 4 1½

Thus, out of a thickness of 574 feet, rocks of organic origin amount to 86 feet, or less than 1 in 6½. The limestones, moreover, are now less in thickness than the coals.

The Roslyn Sandstone of Mid-Lothian is represented by a mass of sandstones, in which, however, fire-clays, clay-ironstones, and limestones attest conditions quite distinct from those of the Millstone Grit of England. The few fossils obtained from them are Limestone species. It is doubtful if the identification of the group has better ground than a desire to harmonize the Scottish and English systematic tables. This group of strata thins away westwards from Mid-Lothian, where it is of minor importance as compared with its English equivalent, and is no longer recognizable in Ayrshire.

The true Coal Measures (or rather in Scotland the Upper Coal Measures, the Carboniferous Limestone series including the Lower Measures) have an estimated maximum thickness of 1800 feet. Save in a thin stratum at Drumpark, east of Glasgow, where a few marine fossils are found, this section of the Carboniferous deposits is of terrestrial or lacustrine origin. The change of movement, if the subsidence of the Carboniferous Limestone series was reversed, was not such as to give rise to unconformity; the Coal Measures, therefore, are separated from the marine series by the absence of marine fossils, rather than by the presence of plants which are foreign to the inferior strata. The vegetable matter presents every variety from the scattered fragments which spot the sandstones, or, in greater quantity, darken the shales, to the free coal or cherry coal which is almost exclusively carbonaceous; from the carbonaceous shale through the blackband ironstone to the cannel or parrot coal. If the free coal represents the accumulation of decayed vegetables on land or in the swamps just above water level, while the carbonaceous sandstones and shales are settlements in deeper water, the blackband ironstones seem to be accumulations in lagoon-like hollows, in limited basins among the

irregularities of the swamps, between islands on which labyrinthodonts basked as do the alligators in tropical regions, the decay of the rank vegetation fixing the iron, while the very abundance of the vegetation, paradoxical as it may sound, is the cause of the partial distribution of the valuable mineral. Both horizontally and vertically do the blackbands shade through cannel into free coals.

The principal seams of the district are as follows:—

Palace Craig Ironstone.	Kiltongue, Mussel-band and Ganot
Ell Coal.	Coal.
{ Pyotshaw Coal.	Kiltongue or Castlehill, 1 Coal.
{ Main Coal.	Drumgray or Castlehill, 2 and 3 Coal.
Humph Coal.	Shotts Gas-coal.
{ Splint or Lady Ann Coal.	Four-foot (Crofthead) Coal.
{ Virgin or Sour Milk Coal.	Two-foot Coal.
Airdrie, Quarter, or Mushat's Black-	Main (Armadale) Coal.
band Ironstone.	Bowhouse Bog Blackband.
Roughband (Cleland) Ironstone.	Crofthead Coal.
Bellside Ironstone.	Slatyband Ironstone.

The thickest seam, the Ell, is 10 feet; the Pyotshaw and Main when united are over 8 feet, but they are separated in the northern part of the area by 48 feet of strata. The ironstones average 8 inches. The strata or sedimentary beds, between the Drumgray and Slatyband seams, thin out northwards, the beds of organic origin thickening in the same direction; and this relation is seen likewise in the Red Sandstones which overlie the Measures. These uppermost beds, separated by a varying interval from the highest coal seams, are unconformable on the coals, and in the Kilmarnock field come to rest on the Carboniferous Limestone. This Red Sandstone series has its counterpart in the west of England, but the Ardwell Limestone of that region is represented in Lanarkshire by marly seams. Whether the southward thickening of the sedimentary strata above the Measures means that they were laid down close to the southern land which yielded the detritus, or that the deeper water lay to the south and received the sediments from a long sloping northern land, matters not when we come to consider what was the former extension of the Coal Measures. Meanwhile it may be mentioned that Professor Geikie finds reason to suspect the north-westerly thinning of the Ayrshire Coal and Limestone series, while the Coal Measures overlap the subjacent strata in the east of that area and rest on the Silurians which form the abrupt *col* separating the Nith valley from the low grounds of Ayrshire. The reference of the Carron valley red rocks to the Carboniferous Limestone series notwithstanding their resemblance to the Coal Measures of Ayrshire, is also open to another interpretation.

The Permian strata are fragmentary in Western Scotland. They occupy hollows in the Silurians, old valleys which existed in Carbon-

iferous times, as near Leadhills and in the valleys of the Nith, Annan, and Loch Ryan, as well as a part of the Ayrshire low grounds, where they rest unconformably on the Coal Measures. Their colour is characteristically red, and large part of the series consists of volcanic rocks, which make up the lower strata and contribute to the superjacent sandstones. The beds found near Leadhills are heavy breccias, with a minimum of cementing material; this boulder-clay-like mass, which perhaps is the result of ice-work, such as Professor Ramsay proved to be recognizable in the English Permians, is referred to the Permians in lack of other evidence: it resembles closely the Moffat breccias. The numerous isolated volcanic orifices or "necks" scattered through Ayrshire and the adjacent counties are referred to the Permian period, which in Scotland seem to have been one of activity and disturbance. These rocks are filled with volcanic agglomerate, represent in fact the contents of a volcanic vent in the act of discharging itself. In Auchenreoch Glen, Vale of Leven, such a neck occurs among the finely stratified Ballagan beds, but the brecciform masses are chiefly fragments of beds a few fathoms below the surface. The surrounding strata dip in towards the orifice.

The next deposits found in the West are those of the glacial period. The Permians are covered by the Trias in the Solway valley, the subsidence of the English area being continued through the Mesozoic period. But in South Scotland no trace is left of any deposits of that series, while in the Western Islands and along the Moray Firth the representatives of the period are fragmentary and local. After Boué and Macculloch, these western Mesozoics have been studied by Murchison, Sedgwick, E. Forbes, Geikie, Wright, Bryce, and Tate. But the most important work regarding them is Mr. Judd's admirable memoir, of which parts are already published in the *Quarterly Journal of the Geological Society of London*. Mr. Judd has recognized the Keuper and Rhœtic beds, the Lias, the Lower, Middle, and Upper Oolites as occurring along the Moray Firth, while the boulder-clay contains fragments telling of the proximity of Cretaceous rocks. In the Western Islands the fragments of the enormous volcanic plateaux which stretched 400 miles from north to south have concealed and preserved strata of Mesozoic age, from the Lias up to the Upper Cretaceous. The lists given at page 99 show how active research has been, nor can the palæontology of the area be even yet considered as exhausted. The leaf-beds at Ardtun in Mull are still unique, and they too deserve renewed investigation in the hope that new light may be thrown on their Miocene contents.

The history of Scotland up to this point may be summed up as follows. The Atlantic land, whose debris furnished the Laurentian sediments, continued to furnish materials to the Cambrians, but already the land surface had extended, for the Cambrians of Scotland

are of that group of deposits which were laid down in closed, probably continental, basins. The Silurians, of marine but probably not of deep-water origin, began to be deposited after a pause, during which the old land surface had been eroded. But Scotland ceased to be an area of Silurian deposit earlier than Wales; the strata were metamorphosed, twisted, and thereafter denuded, while the nearly continuous pile of Welsh sediments was accumulating. To this time may be traced the plain of marine denudation, whose slope is easily recognized from the trigonometrical data; then commenced the atmospheric erosion to which the existing drainage system is due, then in short were fashioned the features of Scotland as we now see it. The Old Red Sandstone, deposited in land-locked basins, swept round the irregular mass of higher ground, and the depression of Central Scotland was perhaps associated with the volcanic activity which marked the earlier accumulations on the Grampian flanks and at Lesmahagow. At this time Scotland and Ireland were united, and the central valley stretched from the east of Scotland, or a little beyond it, to Ireland, where it branched, one opening passing to the north-west, the other to the south-west to the central plain. Again disturbance and denudation, and then the Upper Old Red Sandstone was laid down unconformably on the Lower, and over a smaller area, but under probably similar conditions of geography. Unequal movements on the east and west are attested by the absence of the Upper series in the west, while the unconformity of the two deposits in the Tay valley shows the Upper to have been a low-ground deposit relatively to the elevated and denuded Lower. There is no reason to believe that this Old Red Sandstone ever covered the southern uplands. The argument against it is that the sandstone is found in valleys, as at Lauder, of post-Silurian age, or in the open grounds of the Merse, which was at that time already a plain. If the hills had been covered with Old Red Sandstone, still more if they had been covered with marine Carboniferous rocks, it is impossible to believe that subsequent movements could have restored the slope so exactly that the rivers ran again in their old lines and in none other. The projection of dry land in Scotland from the early Old Red Sandstone down at least to the glacial period seems an inevitable conclusion. Such a barrier, more or less complete, would explain the differences previously noted between the Scottish and English and Irish Carboniferous deposits. During the long continental period extending from the Coal Measures to the glacial period, what was the history of the channel of the Clyde?

The course of the river may be divided into several natural sections:—1st, Its Silurian portion, which terminates between Lamington and Symington; 2d, Its Old Red and Carboniferous portion, thence to near Glasgow; 3d, That portion which extends thence to Greenock, divisible into two, according to our estimate of the barriers above Bowling; 4th, The course in the valley from Gourrock



southwards, the axis of this valley being continuous with that of Loch Long.

Ramsay's "plane of marine denudation," the slope which the hill summits present from the line of heights, Broad Law, Hartfell, Queensberry, would carry the primary stream into the low grounds with a north-westerly course. It emerges from the Silurians at right angles to the great fault, and comes into the open ground leading towards the Tweed. The course of that river from Broughton, at the east end of the Biggar flat, is in the strike of the Silurian beds, is therefore in a secondary valley, as defined by A. Geikie (*Scenery of Scotland*), the primary valleys being those which descend at right angles to the water-parting or line of highest ground. The antiquity of the Tweed course is curiously illustrated by the fragments of channels seen at Mossfennan and Drumelzier. On the face of the hill, above the former locality, a narrow ravine runs parallel to the Tweed, high above the river. The Tinnis Castle above Drumelzier is a rocky knoll, once perhaps used as a British fort; the knoll bounds a fragmentary ravine also parallel to the river; up Drumelzier Burn, on the slope of Finglen Hill, another fragment of a burn course seems to mark the course of the stream which flowed to the Tinnis Castle. Whether or not these high level ravines correspond to the stream which at an early time flowed from west to east over the Old Red Sandstone beds of Biggar, it is difficult to say. The notch through which Biggar burn enters Tweed is in continuation of a secondary Silurian stream, that of Kilbucho. The Old Red range of the Pentlands and Tinto is one partly of elevation, or perhaps more strictly its inequalities date from the time of the volcanic outbursts. An inspection of the map shows that the majority of the streams descending from that range and its south-westerly continuation have a course parallel to the secondary streams of the Silurian. The great fault was later in date than part, at least, of the Old Red Sandstone series, and was no doubt subsequent to the elevation of the Upper Silurian and Lower Old Red Sandstones of the Pentlands and Lesmahagow. All traces of the latter formation have disappeared from the hill ground, but the fact of the Nith commencing amid Carboniferous strata north of the Silurian boundary, and being accompanied south by these deposits, which surmount the *col*, shows that either the Red Sandstone had filled the valley and been removed before the Carboniferous rocks were laid down, or that (though this is less probable) the former strata were never present at that point. The question to be settled is, Did the primary streams of the Silurians continue their courses over the Old Red Sandstone? or did they reshape their courses before the Carboniferous period. Two points must be borne in mind: 1. That the Old Red Sandstone district of Tinto and Douglas belongs to a lower portion of the series than the Pentland series; the trappean rocks of the Pentlands rest unconformably on the Old Red which is conformable

on the Upper Silurians, and are likewise unconformable on the rocks which are conformable on the Upper Silurians of Lesmahagow: 2. That these unconformities were determined by changes of level at an early period. If we bear in mind the probability that the Upper Silurians are unconformable to the Lower,<sup>1</sup> we shall be more inclined to favour the hypothesis, that what is now the Biggar valley had been at a very early period a groove parallel to the strike of the Silurians, into which the waters of the primitive Clyde had been conducted. The Medwyn and the Mouse waters behave as might be expected on the above hypothesis, of streams which descend from the later or unconformable portion of the Old Red: they follow lines parallel to those of the axes of elevation, and repeat in the south-west the course of the Water of Leith in the north-east. The Douglas Water descends to the Clyde in a course which corresponds to that of a stream whose flow dated from the earliest elevation of that district, and it seems as if the union or continuity of the first and second parts of the Clyde had been consequent on the eating back of streams starting from opposite sides of the Pentland ridge, submergence of the land helping to deepen and widen, by means of sea action, the connecting channel. The extreme antiquity of the last part of the Clyde's course, that, namely, which is from north to south, is undoubted. It is a primary valley of which Long Long and Loch Gail are the convergent heads. Denudation has gone far towards opening Loch Long into the Gareloch, and thus giving other "Kyles," the peninsula of Roseneath and Cove being comparable to Bute. The Carboniferous and Old Red Sandstone volcanic bank in North Ayrshire has perhaps helped to deflect the river, as in later times it has undoubtedly shifted the direction of the glaciers descending from the north. But the original position of this part of the Clyde Firth is as independent of the Clyde River as is the Sound of Jura or that of Sleat. The portion of the river from Greenock to Glasgow offers a difficult problem. The Clyde and Kelvin are separated to the east between Hamilton and Kilsyth, by a high bank of ground, this bank running out towards Glasgow. Borings have been consulted, and from these it appears that at Drumry the surface of the rock is 230 feet below sea level: at the water-shed between Forth and Clyde, east of Kilsyth, 110 feet above the sea, a channel of 70 feet sinking below this level, so that its floor is 40 feet above sea level. At Grangemouth the rock is 260 feet below the sea. At Walkinshaw, north-west from Paisley, the rock is 142 feet below the sea: at Shiels, above Renfrew, 122. There is in fact a trough of unequal depth running across from the Clyde

<sup>1</sup> It is possible that the Upper may be conformable on the Lower Silurians, and that the Old Red volcanic tract north of the great fault and the Silurians may represent the place of a secondary valley, parallel to that in which the Tweed flows below Broughton, the passage of the Clyde along Biggar valley being therefore a very ancient event.

valley east of Bowling to the Forth at Grangemouth, and the depth at Drumry in the west is 230 feet below sea level, at Grangemouth 260 feet. Mr. Croll, who proved the existence of the channel, assumed it as probable that these two channels, the Kelvin and Carron, would enter the estuaries on either side at the same or a greater depth than 230 and 260 feet respectively. The slope thus indicated may be taken from the general surface or the floor of the groove:—

W		110		E
		40		
Sea level	— 12 miles	— 15 miles	—	Sea level
280				260

The slope is either on the west 340 feet, or 270 feet in 12 miles; on the east 370, or 300 feet in 15 miles:—

From average rock surface	} to bottom of	{ Eastern Trough, 1 in 214.
		{ Western Trough, 1 in 186.
From bottom of channel	} At Watershed	{ Eastern Trough, 1 in 264.
		{ Western Trough, 1 in 234.

It seems difficult to believe that the Kelvin with such a slope from such a limited drainage area could have done all this work, since the Clyde, a much larger stream, even if the waters above Symington were not added to it, has performed no such feat: it is more difficult when two small streams have simultaneously produced nearly identical results starting from the same water-parting. Yet the sea could not have cut a narrow rock channel, nor should we be prepared to find it hollowing out a cup at one part of an open space. That the excavation was pre-glacial is clear from the fact that boulder-clay is now found in its hollow everywhere except at the water-shed, where the boulder-clay has been removed, and sand and gravel take its place. This removal and replacement Mr. Milne Home, I think rightly, assigns to the action of the sea, the difference of the tidal levels counting for something in the to-and-fro movement of the water across the water-parting when the land stood lower than it now does. But the sea could do little if any of the work on the lower ground, and even an iceberg-laden sea could not have cut out the groove. At present, when not even an erratic fault can be called into aid, the origin of the hollows cannot be accounted for satisfactorily, save perhaps by reference to the Loch Lomond portion of the ice sheet, whose direction, as indicated by the striæ, was up the Clyde. I must now refer to a disputed point between those who have studied the matter. Mr. Croll assumes an outlet to the two basins at or below the levels above mentioned, when the land stood much higher. This is doubted, and the existence of a series of reefs asserted, which, crossing alike the present

Clyde channel and the older buried channel, would make the area east from Bowling a lake with rock barrier, exactly like the other lochs of West Scotland. The ridge between Clyde and Kelvin tapers out westwards towards Garscadden, and thus offers the conditions under which a mass of ice travelling east would form one of Mr. Geikie's *deflection basins*, i.e. a deep hollow ground out by the ice as it is delayed in front of an obstruction, by which it is divided in two. On the east side it is noteworthy that the deepest part of the firth at present is at Inchgarvie, an island dividing the firth just above the headlands of North and South Queensferry. Those who assert the rocky barrier do so on the ground that dykes and interbedded traps cross the valley, intrusive but persistent, and of considerable breadth, one of them, at Elderslie, covering 900 by 300 yards of the channel. Farther down, at Rashielee, and again at Erskine, similar dykes have been followed from the high grounds to the south, so far north as to justify the anticipation of their further extension. The proximity to each other of the points at which these rocks have been observed on the south side, seems to preclude the possibility of a channel there existing. The bores at Walkinshaw, showing rock at 142 feet below sea level, were within the line of the Rashielee traps, and the 360 feet of surface covering at Cleddans, Duntocher, was also obtained within its conjectured extension. The question is therefore one on which decisive information has still to be gained. But I incline to the belief in the shallow mouth of the basin. One circumstance has great importance, in my opinion; the deposits passed through in the bores furthest west seem nowhere to contain shells any distance below the present outflow of the river. The evidence is negative, but it precludes us from assuming the marine character of the accumulation; the shell-clays are all at higher levels. The conjecture of Mr. Dugald Bell, supported by Mr. J. Geikie, that the Lomond glacier with its moraine dammed back the waters of the Clyde basin above Bowling, forcing the overflow by Lochwinnoch and Kilbirnie, satisfactorily accounts for the deposits, assuming the glacial erosion of the deepest portions of the hollow. The Lochwinnoch *col* is lower than that of Kilsyth at present, but higher than the floor of the rock channel described by Messrs. Bennie and Croll. If the latter was already charged with boulder-clay when the Lomond glacier dammed back a lake, the absence of boulder-clay in some of the deepest bores is a curious difficulty. If, on the other hand, the channel was free, the hypothesis of glacial erosion in the western basin raises another difficulty, for either the ice left no boulder-clay or its rubbish had been removed. Still another question rises, which, so far as I know, has not been touched on. The Old Red Sandstone and the Permian land masses were, as Professor Ramsay has pointed out, the seats of glaciers, and the Chalk area of South England seems to have been visited during the deposition of that limestone by at least bergs. What share did the glaciers of

those times take in the production of our land features? Ramsay's views are dismissed in a sentence in the text-books, and even in his *Physical Geology and Geography of Great Britain* they are summarily stated. But if we can assign to that earlier glaciation any important share in denudation, some at least of the deposits now called inter-glacial, but found in contact with rocks, may be in reality pre-glacial.

The events of the glacial epoch have been exhaustively discussed by Mr. James Geikie, while Mr. D. Robertson's and Mr. Crosskey's notes and papers contain all that is known regarding the fauna of the period. The local character of the till is well seen in this district, while the attention which has been given to the Palaeozoic rocks has led to the detection of the sources whence nearly all the boulders were brought. A table case in the Hunterian Museum contains a series of hand specimens obtained by Mr. Young from the boulders which were removed when the summit of Gilmorehill was lowered for the foundation of the University. The series includes all varieties of rock from Bonawe to the Kilpatrick. The glacial striations of the district are generally from north-west to south-east, but variations are met with due for the most part to surface features and to the varying mass of the moving ice. The variation frequently records itself by superposed striae, the two planes of the successive movements being thus apparent. To the south of Glasgow the striations of the high grounds seem to suggest movement alternately in opposite directions. It would be foreign to the design of this paper to discuss the interglacial deposits on which Mr. J. Geikie, following Mr. Croll, lays so much weight; sufficient is it to say that in the Clyde basin we have examples of every product of glacier work, and in the multitudinous sections which the district offers there is ample material for testing the value of speculations, always bearing in mind Professor Ramsay's caution against exaggerating the importance of the glacial deposits as a whole, and treating them as of equal magnitude with the Silurians or other Palaeozoic series.

The fossiliferous clays have been fully reported on by Mr. Robertson; it is therefore unnecessary to do more than refer the reader to the accompanying lists, the more so that the data are as yet insufficient for any generalizations regarding the distribution of particular forms.

But it may not be amiss to remind the geologist that the sands and gravels of Carstairs were to Agassiz, thirty years ago, moraines, that Glen Cloy and Glen Rosa in Arran contain well-preserved morainic mounds, terminal and lateral, and that the entire absence even of the waste of the boulder-clay from such tracts as the summit of the Mugdock and Craigmaddie heights, to the north of Glasgow, is even a more difficult matter to explain than the absence of flint gravel from the Weald escarpments. The descent of glaciers so nearly to the sea level in Arran and in Glen Messan (Holy Loch) is

interesting, since in Peeblesshire the well-preserved moraines of Manor, Megget, Winterhope, and Loch Skene do not come below the 1100-foot contour line.

The silting up and artificial clearing of the Clyde channel have been discussed by Mr. Deas, C.E., but among the remains of later date than the glacial clays and earlier than the Romans are those canoes which have been found from time to time in silts bordering the Clyde, and which, with their owners' clubs and other weapons, may have sunk during storms which were dangerous, because the Clyde of those days was no narrow stream but a broad if shallow lake. Some of these canoes are in the Hunterian and Andersonian, and in the Botanical Garden are deposited two found near Bowling.



# CATALOGUE

OF THE

## WESTERN SCOTTISH FOSSILS.

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### THE SILURIAN SYSTEM IN THE SOUTH OF SCOTLAND.

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INTRODUCTION.  
MOFFAT DISTRICT.

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#### INTRODUCTION.

THE broad undulating district lying to the south of the Carboniferous basin of Central Scotland, and known under the general name of the SOUTHERN UPLANDS, is carved almost wholly out of rocks of Silurian age. The dominant formation is an immense series of comparatively barren greywackes and shales, which, thrown into innumerable folds and contortions, spread in an unbroken sheet from St. Abb's Head to the Mull of Galloway, forming by far the grandest exhibition of Middle Silurian strata yet discovered. This great group, various portions of which are known under very different local titles, is conveniently denominated the VALENTIAN formation, after the ancient Roman name of South Scotland.

Along the line of the deeper anticlinals in the central areas it is seen to repose upon the group of Black shales, known as the Moffat Series, which are the most ancient rocks now visible in the district under notice. To the south it passes below the *Riccarton* beds, which yield numerous fossils of Wenlock age. To the north, along an irregular line running from Girvan to Dunbar, these *Valentian* beds are faulted against the Upper Palæozoic deposits, or are covered up by them unconformably. But in two small areas, at Lesmahagow and the Pentland Hills, lying near the middle of the Carboniferous basin, denudation has exposed a great thickness of true *Upper Silurian* strata, which afford evidence of a gradual lithological transition into the overlying rocks of the Old Red Sandstone.



The only rocks of this wide-spreading Silurian area that fall to be noticed in greater detail are those occurring in the counties of Lanark and Ayr, and in the neighbourhood of the town of Moffat, Dumfriesshire. Their inter-relationships are expressed in the following table:—

	Eastern Districts.	Lanarkshire.	Ayrshire.	English Equivalents.
<div>Upper Silurian.</div> <div> <div>Upper.</div> <div>Middle.</div> <div>Lower.</div> </div>	Lyne Sandstones.	Leamnahagow Beds.	—	Downton.
	Upper Pentlands.	—	—	Ludlow.
	Lower Pentlands.	—	—	Wenlock.
	Riccarton Beds.	—	—	
	Hawick Rocks.	—	—	Taranon.
	Gala Group.	Valentian.	Upper Girvan.	Mayhill.
	Birkhill Shales.		Lower Girvan.	Llandoverly.
			—	
	Hartfell Shales.		Craighead Limestone.	} Bala.
	Glenkiln Shales.	Leadhills Shales.	—	
			—	Llandello.

## MOFFAT DISTRICT.

Under this name is included the elevated area drained by the higher streams and tributaries of the Annan, Tweed, Yarrow, and Etrick, the watershed dividing the basins of the Tweed and Annan passing irregularly through its centre. Along this line occur some of the principal summits of the south of Scotland, such as Whitecombe (2695), Hartfell (2422), Capel Fell (2400). To the north and south the country descends gradually in a sea of broad-backed hills and deep narrow valleys. With the exception of the central parts of the vale of the Annan the district is pre-eminently pastoral, there are few boggy moorlands or areas of bare rock, but the hills are covered with short grass from base to summit. This country is carved out of the Valentian rocks—here an endless succession of singularly barren grits, greywackes, and shales—and the underlying *Moffat Series* (which receive their name from the only town of the district), and which come to the surface only along a few of the more important anticlinals. These beds of black shale run across the country in long lines of irregular diameter, or occupy lenticular or boat-shaped areas, of which the width is a very small fraction of the length. Though the lines frequently cross some of the greater ridges transversely, yet, owing to the fact that they naturally yield more readily to the forces of denudation than the hard grits of the overlying *Middle Valentian* series, the dark shales normally occur in the beds and banks of the various mountain streams; the junction of the two dissimilar rock-groups being often marked by a picturesque waterfall. Where the rocks are but slightly disturbed, the highest zones of each black shale area occur of necessity on its lateral margins, and the deepest strata in its centre. The unravelling of the succession, however, is everywhere a matter of great difficulty, as the strata are full of perplexing inversions, and the soft shales themselves are contorted, wrinkled, and faulted to an extraordinary degree. The following is the sequence of the Moffat series in this district, the total thickness of the beds being under 600 feet:—

1. UPPER MOFFAT.—*Birkhill Shales*.
  - (b) Alternations of black and gray shales, containing several conspicuous lines of white clay.
  - (a) Black carbonaceous flags and shales, underlaid by gray and brown bands, and with numerous thin bands of ironstone nodules.
2. MIDDLE MOFFAT.—*Hartfell Shales*.
  - (b) A thick zone of greenish shale and mudstone, with a few fossiliferous bands near the base.
  - (a) Black carbonaceous shales: upper portions highly fossiliferous; lower portion comparatively barren and containing a marked band of highly siliceous flagstone.

3. LOWER MOFFAT.—*Glenkiln Shales.*

- (a) Alternations of white, orange, and greenish mudstone and sandy shales with black bands containing fossils.

The principal fossils of the Moffat shales are Graptolites, which occur in some localities in extraordinary profusion. The chief forms are represented in the accompanying plates. In addition to Graptolites there are some species of *Brachiopoda*, and rarer fragments of Sponges, Trilobites, and *Eurypterida*.

The geological age of the Lower Moffat is *Llandeilo*, the Middle Moffat represents part of the *Bala* formation, and the Upper Moffat seems to belong almost wholly to the *Lower Llandovery*.

The best-marked of the anticlinals exposing these strata in the present district are—

- I. *Ettrick Band*, ranging from Berrybush (Selkirkshire) up the higher reaches of the Ettrick, and thence through Craigmichan, Belcraig, and Duffkinnel to Glenkiln near Dumfries.
- II. *St. Mary's Loch Bands*, exposed in March Burn, Whitehope Burn, Riskinhope, and Kirkhope.
- III. *Polmoody Band*, running from the Moffat valley to that of the Meggat.
- IV. *Carrifran Band*, seen in Bodsbeck, Carrifran, Whitecombe, &c.
- V. *Hartfell Band*, running through Povtburn, Hartfell, Headshaw, Greskin, Rivoz, &c.

## CHIEF LOCALITIES FOR FOSSILS.

Locality.	Strata Exposed.	Distance from Moffat.
Garple, ...	Upper Moffat shales, ...	2 miles.
Frenchland Burn, ...	" "	1 "
Belcraig, ...	Lower and Upper Moffat shales, ...	4 "
Hartfell, ...	Middle Moffat shales, ...	6 "
Duffkinnel, ...	Upper Moffat shales, ...	10 "
Glenkiln, ...	Lower, Middle, and Upper shales, ...	20 "
Dobb's Linn, ...	" "	10 "
Mount Benger Burn, ...	Middle and Upper shales, ...	20 "

## FOSSILS OF THE MOFFAT SERIES.

Graptolithina.		Birkhill Shales.	Hartfell Shales.	Glenkiln Shales.
<i>RASTRITES, Barrande.</i>				
capillaris, Carr.	Plate I. fig. 5	x		
distans, Lapw.	" " 2	x		
hybridus, Lapw.	" " 4	x		
maximus, Carr.	" " 1	x		
peregrinus, Barr.	" " 3	x		
<i>MONOGRAPTUS, Geinitz.</i>				
argutus, Lapw.	" " 12	x		

		Birkhill Shales.	Hartfell Shales.	Glenkiln Shales.
<b>Monograptus—continued.</b>				
attenuatus, <i>Hopk.</i>	Plate I. fig. 6	x		
Clingani, <i>Carr.</i>	" " 24	x		
concinus, <i>Lapw.</i>	" " 10	x		
convolutus (communis), <i>His.</i>	" " 18	x		
var. fimbriatus, <i>Nich.</i>	" " 19	x		
var. proteus, <i>Barr.</i>	" " 20	x		
var. spiralis, <i>Geinitz.</i>	" " 21	x		
cyphus, <i>Lapw.</i>	" " 15	x		
gregarius, <i>Lapw.</i>	" " 7	x		
Halli, <i>Barr.</i>	" " 16	x		
intermedius, <i>Carr.</i>	" " 8	x		
jaculum ( <i>Hisingeri</i> ), <i>Carr.</i>	" " 13	x		
leptotheca, <i>Lapw.</i>	" " 14	x		
lobiferus, <i>M'Coy.</i>	" " 25	x		
runcinatus, <i>Lapw.</i>	" " 26	x		
Sandersoni, <i>Lapw.</i>	" " 9	x		
Sedgwickii, <i>Portlock.</i>	" " 17	x		
tenuis, <i>Portlock.</i>	" " 11	x		
triangulatus, <i>Harkn.</i>	" " 22	x		
turriculatus, <i>Barr.</i>	" " 23	x		
<b>LEPTOGRAPTUS, Lapworth.</b>				
capillaris, <i>Carr.</i>	" " 72	...	x	
flaccidus, <i>Hall.</i>	" " 73	...	x	x
<b>AMPHIGRAPTUS, Lapworth.</b>				
divergens, <i>Hall.</i>	" " 70	...	x	
radiatus, <i>Lapw.</i>	" " 71	...	x	
<b>PLEUROGRAPTUS, Nicholson.</b>				
linearis, <i>Carr.</i>	" " 69	...	x	
<b>CENOGRAPTUS, Hall.</b>				
explanatus, <i>Lapw.</i>	" " 68	...	...	x
gracilis, <i>Hall.</i>	" " 65	...	...	x
(? <i>Trichograptus, Nich.</i> ) niti-				
dulus, <i>Lapw.</i>	" " 66	...	...	x
per-tenuis, <i>Lapw.</i>	" " 67	...	...	x
surcularis, <i>Hall.</i>	" " 64	...	...	x
<b>DICELLOGRAPTUS, Hopkinson.</b>				
anceps, <i>Nich.</i>	Plate IV. fig. 82	x		
caduceus, <i>Lapw.</i>	" " 83	...	x	
divaricatus, <i>Hall.</i>	" " 86	...	...	x
elegans, <i>Carr.</i>	" " 87	...	x	
Forchammeri, <i>Geinitz.</i>	" " 88	...	x	
var. articulatus, <i>Lapw.</i>	" " 89	...	x	
var. flexuosus, <i>Lapw.</i>	" " 90	...	...	x
Moffatensis, <i>Carr.</i>	" " 84	...	x	x
Morrisii, <i>Hopk.</i>	" " 85	...	x	
pumilus, <i>Lapw.</i>	" " 81	...	x	

		Birkhill Shales.	Hartfell Shales.	Glenkiln Shales.
<b>DICRANOGRAPTUS, Hall.</b>				
<i>Clingani, Carr.</i>	Plate III. fig. 76	...	x	
<i>formosus, Hopk.</i>	" " 75	...	...	x
<i>Nicholsoni, Hopk.</i>	" " 79	...	x	x
<i>ramosus, Hall.</i>	Plate IV. fig. 80	...	x	x
<i>sextans, Hall.</i>	Plate III. fig. 78	...	...	x
<i>ziczac, Lapw.</i>	" " 77	...	...	x
<i>var. minimus, Lapw.</i>	" " 77A	...	...	x
<b>DIDYMOGRAPTUS, M'Coy.</b>				
<i>superstes, Lapw.</i>	" " 74	...	...	x
<b>DIPLOGRAPTUS, M'Coy.</b>				
<i>aculeatus, Lapw.</i>	Plate II. fig. 44	...	x	
<i>acuminatus, Nich.</i>	" " 36	x		
<i>angustifolius, Hall.</i>	" " 35	...	...	x
<i>cometa, Geinitz.</i>	" " 31	x		
<i>foliaceus, Murch.</i>	Plate I. fig. 29	...	x	x
<i>var. calcaratus, Lapw.</i>	Plate II. fig. 30	...	x	
<i>Hughesii, Nich.</i>	" " 37	x		
<i>insectiformis, Nich.</i>	" " 40	x		
<i>modestus, Lapw.</i>	" " 33	x		
<i>palmeus, Barr. (D. folium, His. Auct.)</i>	Plate I. fig. 27	x		
<i>penna, Hopk. Geol. Mag. Dec. 1,</i>	vol. ix. Pl. XII fig. 6.	x		
<i>per-excavatus, Lapw.</i>	Plate II. fig. 38	...	...	x
<i>physophora, Nich.</i>	" " 42	x		
<i>pristis, His. var. truncatus.</i>	Plate I. fig. 28	x	x	
<i>quadrimumcronatus, Hall.</i>	Plate II. fig. 43	...	x	
<i>sinuatus, Nich.</i>	" " 32	x		
<i>tamariscus, Nich.</i>	" " 34	x		
<i>tricornis, Carr.</i>	" " 39	...	...	x
<i>vesiculosus, Nich.</i>	" " 41	x		
<i>Whitfieldii, Hall.</i>	" " 45	...	...	x
<b>CLIMACOGRAPTUS, Hall.</b>				
<i>bicornis, Hall.</i>	" " 51	...	x	x
<i>var. peltifer, Lapw.</i>	" " 53	...	...	x
<i>var. tridentatus, Lapw.</i>	" " 52	...	x	x
<i>var. tuberculatus, Nich. An. Mag.</i>	Nat. Hist. 1869, vol. iv. pl. XI.			
<i>fig. 18.</i>		x		
<i>caudatus, Lapw.</i>	Plate II. fig. 48	...	x	
<i>celatus, Lapw.</i>	" " 56	...	...	x
<i>innotatus, Nich.</i>	" " 54	x		
<i>minutus, Carr. Geol. Mag. Dec. 1,</i>	vol. v. Pl. V. fig. 10.	x		
<i>rectangularis, M'Coy.</i>	Plate II. fig. 50	x		
<i>scalaris, His.</i>	" " 47	x		
<i>Scharenbergi, Lapw.</i>	" " 55	...	x	x

		Birkhill Shales.	Hartfell Shales.	Glenkiln Shales.
<i>Climacograptus—continued.</i>				
<i>tubuliferus, Lapw.</i>	Plate II. fig. 49	...	x	
<i>Wilsoni, Lapw.</i>	" " 46	...	x	
<i>GLOSSOGRAPTUS, Emmons.</i>				
<i>Hincksii, Hopk.</i>	Plate II. figs. 57, 57A	...	x	x
<i>HALLOGRAPTUS, Nich.</i>				
<i>bimucronatus, Nich.</i>	Plate II. fig. 58	...	...	x
<i>LASIOGRAPTUS, Lapworth.</i>				
<i>costatus, Lapw.</i>	" " 59	...	x	x
<i>margaritatus, Lapw.</i>	" " 60	...	x	
<i>Harknessi, Nich.</i>			x	
<i>RETIOLITES, Barrande.</i>				
<i>fibratus, Lapw.</i>	Plate III. fig. 62	...	x	
<i>perlatus, Nich.</i>	" " 61	x		
<i>CLATHROGRAPTUS, Lapworth.</i>				
<i>cuneiformis, Lapw.</i>	" " 63	...	...	x
<i>CORYNOIDES, Nicholson.</i>				
<i>calicularis, Nich.</i>	Plate IV. fig. 91	...	x	x
<i>curtus, Lapw.</i>	" " 92	...	x	
<i>gracilis, Hopk.</i>	" " 93	...	x	
<i>THAMNOGRAPTUS, Hall.</i>				
<i>Barrandii, Hall.</i>	" " 95	...	...	x
<i>Scoticus, Lapw.</i>	" " 94	...	...	x
<i>typus, Hall.</i>	" " 96	...	...	x
<sup>1</sup> <i>DICTYOGRAPTUS, Hall.</i>				
<i>Moffatensis, Lapw.</i>	" " 97	...	x	

## Crustacea.

<i>APTUCHOPSIS, Henry Woodward.</i>				
<i>Lapworthii, H. Woodw. Geol. Mag. Dec. 1,</i> <i>vol. ix. p. 565.</i>		x		
<i>PELTOCARIS, Salter.</i>				
<i>aptychoides, Salter. Q. J. G. S. viii. p. 391.</i>		x		
<i>DISCINOCARIS, Henry Woodward.</i>		...		
<i>Browniana, Woodw. Q. J. G. S. xxii. Plate xxv.</i>		x		
<i>OYGIA, Brongniart.</i>				
<i>Buchii, var. convexa, Brongn.</i>		...	...	x
<i>EURIPTERUS, Dekay.</i>		...		
<i>sp.</i>		...	x	
<i>DAWSONIA, Nich.</i>				
<i>campanulata, Nich. An. Mag. Nat. Hist. 1872.</i>		x		

<sup>1</sup> The following forms have also been figured from the Moffat shales:—

1. *Graptolites incinus*, Harkness, *Quart. Journ. Geol. Soc.* vii. Pl. I. fig. 8.
2. *Diplograptus pennatus*, Harkness, *ibid.* fig. 9.
3. *D. nodosus*, Harkness, *ibid.* fig. 10.

The first is too fragmentary to be identified; the others are very doubtful species.  
—C. L.

Brachiopoda.		Birkhill Shales.	Hartfell Shales.	Glenkiln Shales.
<i>ACROTBETA, Kutorga.</i>				
Nicholsoni, <i>Dav.</i>	Geol. Mag. Dec. 1, vol. v. p. 313.	...	x	
<i>DISCINA, Lamarck.</i>				
Portlockii, <i>Geinitz.</i>	Die Graptolithen, Taf. I. fig. 31.	...	x	x
<i>LINGULA, Bruguière.</i>				
brevia, <i>Portlock.</i>	Geol. Rep. Lond. p. 443.	...	x	
<i>SIPHONOTRETA, De Verneuil.</i>				
micula, <i>M'Coy.</i>	Siluria, Foss. ii. fig. 17.	...	x	

**VALENTIAN ROCKS (GALA GROUP).**—These are made up, as already mentioned, of masses of almost barren grits, flagstones, and shales. The grits are well exposed in the hills immediately north of Moffat (Queensberry grits of H.M. Geological Survey), and pass sometimes into a coarse conglomerate (Bannock rock), as above Wellfield Quarry.

The predominant strata are the flagstones and shales, of which good examples are visible in the well-known quarries of Hunterheck.

The few fossils hitherto procured from these beds are named in the accompanying list.

#### FOSSILS OF THE GALA GROUP IN THE MOFFAT NEIGHBOURHOOD.

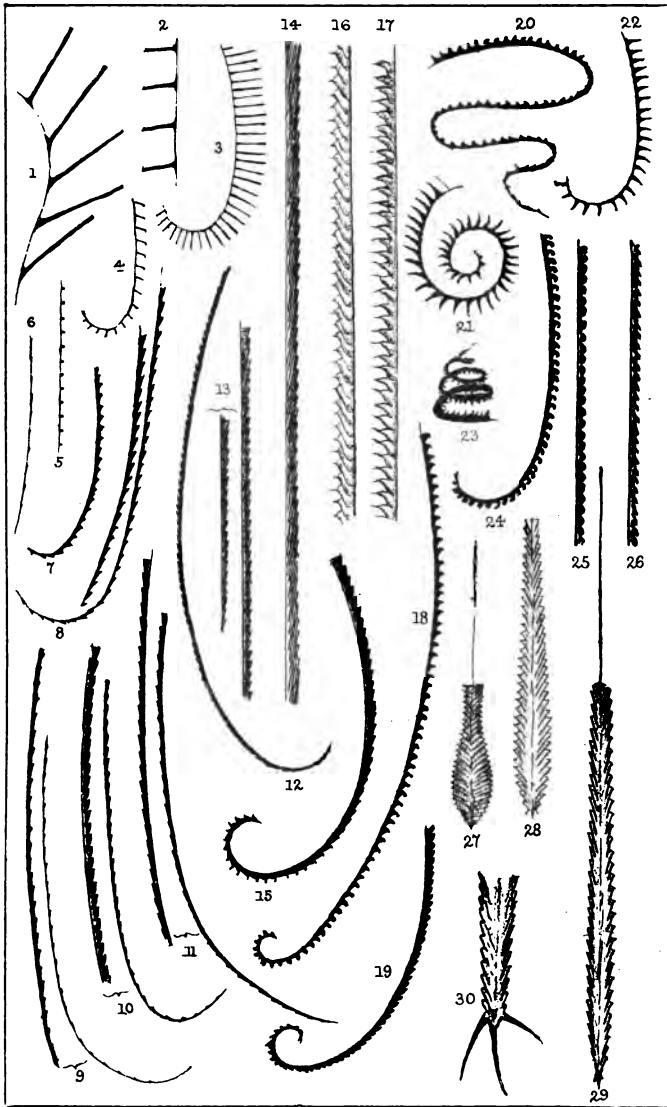
<b>GRAPTOLITES</b> <i>Galaensis, Lapw.</i>		Tushielaw.
exiguus, <i>Nich.</i>		Tushielaw, Berrybush, Glenkiln, Brockhope.
Hallii, <i>Barr.</i>		Tushielaw, Glenkiln.
Hisingeri, <i>Carr.</i>		Brockhope, Berrybush.
lobiferus (Beckii), <i>M'Coy.</i>		Berrybush.
priodon, <i>Bronn.</i>		Tushielaw, Mount Benger Burn.
Sedgwickii, <i>Portl.</i>		Altrive, Tushielaw.
<b>CROSSOPODIA, M'Coy.</b>		
Scotica, <i>M'Coy.</i>		Hunterheck.
<b>DEXOLITES, Hopkinson.</b>		
gracilis, <i>Hopk.</i>		Hunterheck.

#### EXPLANATION OF PLATE I.

<b>FIG.</b>	<b>FIG.</b>
1. <i>Rastrites maximus, Carr.</i>	8. <i>Monograptus intermedius, Carr.</i>
2. <i>distans, Lapw.</i>	9. <i>Sandersoni, Lapw.</i>
3. <i>peregrinus, Barr.</i>	10. <i>concinuus, Lapw.</i>
4. <i>hybridus, Lapw.</i>	11. <i>tenuis, Portl.</i>
5. <i>capillaris, Carr.</i>	12. <i>argutus, Lapw.</i>
6. <i>Monograptus attenuatus, Hopk.</i>	13. <i>Hisingeri, v. jaculum, Carr.</i>
7. <i>gregarius, Lapw.</i>	14. <i>leptotheca, Lapw.</i>

MOFFAT GRAPTOLITES.

Plate I.



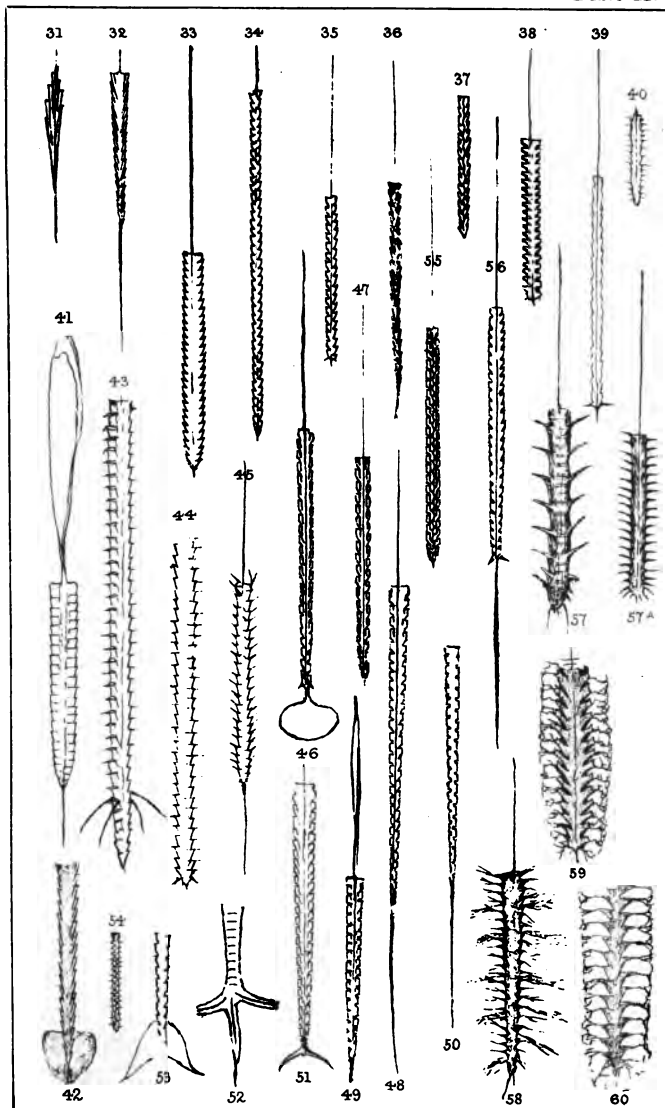
Chas. Lapworth, del. et lith.





MOFFAT GRAPTOLITES.

Plate II.

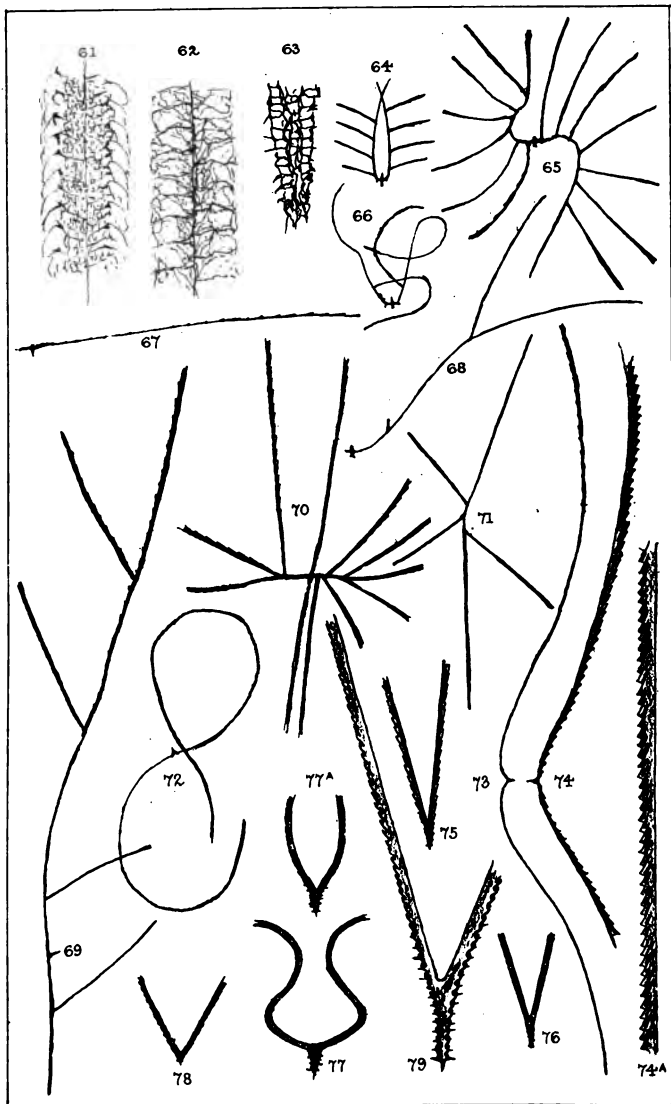


Chas. Lapworth, del. et lith.



MOFFAT GRAPTOLITES.

Plate III.

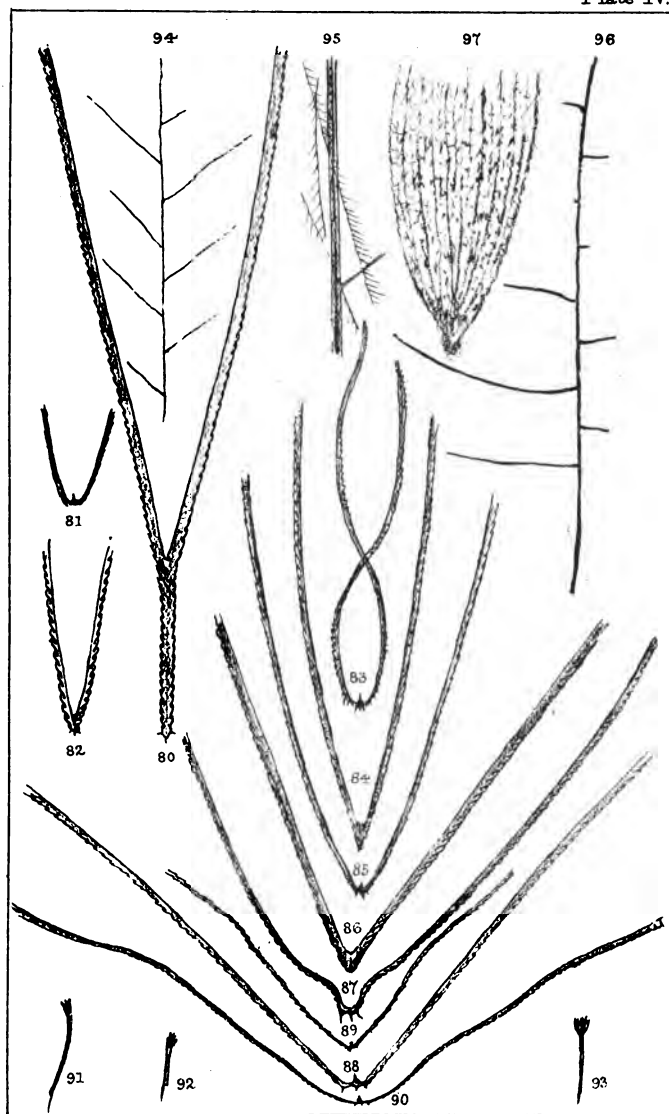


Chas. Lapworth, del et lith.



# MOFFAT GRAPTOLITES.

Plate IV.



Chas. Lapworth, del. et lith.



- FIG.  
15. *Monograptus cyphus*, *Lapw.*  
16. *Halli*, *Barr.*  
17. *Sedgwickii*, *Portl.*  
18. *convolutus*, v. *communis*, *His.*  
19. v. *umbriatus*, *Nich.*  
20. v. *proteus*, *Barr.*  
21. v. *spiralis*, *Geinitz.*  
22. *triangulatus*, *Hark.*

- FIG.  
23. *Monograptus turriculatus*, *Barr.*  
24. *Clingani*, *Carr.*  
25. *lobiferus*, *M'Coy.*  
26. *runcinatus*, *Lapw.*  
27. *Diplograptus palmeus*, *Barr.*  
28. *pristis*, v. *truncatus*,<sup>1</sup> *His.*  
29. *foliaceus*, *Murch.*  
30. v. *calcaratus*, *Lapw.*

## EXPLANATION OF PLATE II.

- FIG.  
31. *Diplograptus cometa*, *Geinitz.*  
32. *sinuatus*, *Nich.*  
33. *modestus*, *Lapw.*  
34. *tamariscus*, *Lapw.*  
35. *angustifolius*, *Hall.*  
36. *acuminatus*, *Nich.*  
37. *Hughesii*, *Nich.*  
38. *perezcavatus*, *Lapw.*  
39. *tricornis*, *Carr.*  
40. *insectiformis*, *Nich.*  
41. *vesiculatus*, *Nich.*  
42. *physophora*, *Nich.*  
43. *quadrimumcronatus*, v. *spinigerus*,  
    *Hall.*  
44. *aculeatus*, *Lapw.*  
45. *Whitfieldii*, *Hall.*

- FIG.  
46. *Climacograptus Wilsoni*, *Lapw.*  
47. *scalaris*, *His.*  
48. *caudatus*, *Lapw.*  
49. *tubuliferus*, *Lapw.*  
50. *rectangularis*, *M'Coy.*  
51. *bicornis*, *Hall.*  
52. v. *tridentatus*, *Lapw.*  
53. v. *peltifer*, *Lapw.*  
54. *innotatus*, *Nich.*  
55. *Scharenbergi*, *Lapw.*  
56. *coelatus*, *Lapw.*  
57. *Glossograptus Hincksii* (ventral aspect),  
    *Hopk.*  
57a. *Glossograptus Hincksii* (lateral aspect).  
58. *Hallograptus bimucronatus*, *Nich.*  
59. *Lasiograptus costatus*, *Lapw.* × 2.  
60. *margaritatus*, *Lapw.* × 2.

## EXPLANATION OF PLATE III.

- FIG.  
61. *Retiolites perlatius*, *Nich.* × 2.  
62. *fibriatus*, *Lapw.* × 2.  
63. *Clathrograptus cuneiformis*, *Lapw.* × 2.  
64. *Ctenograptus surcularis*, *Hall.*  
65. *gracilis*, *Hall.*  
66. *nitidulus*, *Lapw.*  
67. *pertenuis*, *Lapw.*  
68. *explanatus*, *Lapw.*  
69. *Pleurograptus linearis*, *Carr.*  
70. *Amphigraptus divergens*, *Hall.*

- FIG.  
71. *Amphigraptus radiatus*, *Lapw.*  
72. *Leptograptus capillaris*, *Carr.*  
73. *flaccidus*, *Hall.*  
74. *Didymograptus superstes*, *Lapw.*  
75. *Dicranograptus formosus*, *Hopk.*  
76. *Clingani*, *Carr.*  
77. *zizac*, *Lapw.*  
77a. v. *minimus*, *Lapw.*  
78. *sertans*, *Hall.*  
79. *Nicholsoni*, *Hopk.*

## EXPLANATION OF PLATE IV.

- FIG.  
80. *Dicranograptus ramosus*, *Hall.*  
81. *Diocellograptus pumilus*, *Lapw.*  
82. *anoepe*, *Nich.*  
83. *caducius*, *Lapw.*  
84. *Moffatensis*, *Carr.*  
85. *Morrissii*, *Hopk.*  
86. *divaricatus*, *Hall.*  
87. *elegans*, *Carr.*

- FIG.  
88. *Diocellograptus Forchammeri*, *Geinitz.*  
89. v. *articulatus*, *Lapw.*  
90. v. *flexuosus*, *Lapw.*  
91. *Corynoides calicularis*, *Nich.*  
92. *curtus*, *Lapw.*  
93. *gracilis*, after *Hopk.*  
94. *Thamnograptus Scotticus*, *Lapw.*  
95. *Barrandii*, *Hall.*  
96. *typus*, *Hall.*  
97. *Dictyograptus Moffatensis*, *Lapw.*

<sup>1</sup> The species and varieties in italics are new forms as yet undescribed.—C. Lapworth, July, 1876.



## LEADHILLS DISTRICT.

This district lies in the Upper Ward of Lanarkshire, between the higher portions of the valleys of the Clyde and Nith, and has for its centre the lead-mining area of Wanlockhead. It is a bleak extent of heathy moorland, cut into several irregular ridges, the culminating points of which rise to heights of from 1400 to 1500 feet. The long mound of the Lowther Hills (2403 feet) forms the southern boundary of the area. Its northern limit is the great north-east and south-west fault bounding the Carboniferous basin. As in the Moffat area the country is floored mainly by *Valentian* strata, here, however, often much altered and mineralized. There are the usual long lines and patches of the underlying Black Shales in abundance—the latter, however, being rarely in a state admitting of the preservation of their included fossils. The various Black Shale bands are accurately laid down on the map of the district published by the Geological Survey, which should be referred to for further detail. The best-developed bands are those of the valley of the Wanlock, the hill slopes to the south of the Glengonnar Water, and their north-easterly continuation on the opposite side of the Clyde. The most fossiliferous localities are Sowen Dod, Reecleuch Hill, Laggan Gill, and Birnock.

There are no Birkhill shales in this district (unless indeed they are represented by the lowest *Valentian* zones), the highest Black Shales visible being the top zones of the Middle Moffat or *Hartfell Shales*. The Lower Moffat shales occur in most localities, and the peculiar indurated bands of siliceous flag are often remarkably conspicuous. Every fossil of the Lower Moffat Shales has already been collected from this area, and there seems to be a perfect similarity in their vertical range in the Leadhills and Moffat districts.

**VALENTIAN ROCKS.**—These are almost identical in lithological character with those of the Moffat area, but the coarser strata, near the base of the formation, pass sometimes into important conglomeritic masses (like the Bannock Stone of Moffat) made up of rounded or angular fragments of quartz, greywacke, and igneous rocks. The most striking feature of these deposits is their rapid variation in character as we follow them along the line of strike, passing from mere bedded pebbly grits into enormous heterogeneous sheets of bouldery breccia. Sometimes they contain fossiliferous zones, as at Duntercleuch, Snar, Wallace's Cast, &c. These beds, when traced along the strike, rapidly lose their fossiliferous character and degenerate into the normal barren greywacke. On the same horizon, however, similar fossiliferous bands occur to the north-east in Peeblesshire, at Wrae Hill, Stobo, Kilbucho, and Winkstone, and to the south-west, near Moniaive, and Dalry. The fossils (the chief of which are given on table A.) show that the beds are in all pro-

bability of Llandovery age, and the continuation of the fossiliferous deposits of the Girvan area next to be described.

*Note.*—The order of succession among the Silurians of the Southern Uplands here given is somewhat different from that adopted by the officers of the Geological Survey, which the reader will find expounded in detail in the explanations to Sheets XV. and III. of the Geological Survey of Scotland. An excellent *resumé* of their views is given by Professor Harkness in *Nature* for October, 1873. So far as can be gathered from the pamphlets alluded to, the following is regarded as the sequence of the rocks in the districts of Moffat and the Leadhills, arranged in descending order:—

C. *Caradoc Beds* of Duntercleuch, &c.

D. *Llandeilo Rocks*.

D. 7. Upper Black Shales (Leadhills Shales) of Wanlockhead, &c.

D. 6. Lowther Shales.

D. 5. Haggis Rock Group.

D. 4. Dalveen Group.

D. 3. Daer Group = Queensberry Grits of Sheet 3.

D. 2. Hartfell Shales = Moffat Shales or Lower Black Shales.

D. 1. Ardwell Beds.

The Duntercleuch Beds and their equivalents are considered as lying unconformably upon the "Llandeilo" rocks, and to be the equivalents of some of the Girvan beds.

#### FOSSILS OF THE LEADHILLS DISTRICT.

##### A. Fossils of the DUNTERCLEUCH BEDS.—Geol. Survey of Scotland, Explanation of Sheet XV.

*Nidulites favus*, *Salter*.

*Favosites aspera*, *D'Orb*.

*Nebulipora lens*, *M'Coy*.

*Petraia bina*, *Lonsd.*

*elongata*, *Phill.*

*uniserialis*, *M'Coy*.

*Stenpora fibrosa*, *Goldf.*

*Glyptocrinus basalis*, *M'Coy*.

*Phacops candatus*, *Brunn.*

*Trinucleus fimbriatus*, *Murch.*

*Ptilodictya dichotoma*, *Portl.*

*Atrypa hemispherica*, *Sow.*

*marginalis*, *Dalm.*

*Leptaena tenuicincta*, *M'Coy*.

*transversalis*, *Dalm.*

*sericea*, *Sow.*

*Meristella angustifrons*, *M'Coy*.

*Orthis Actonise*, *Sow.*

*Bouchardii*, *Dav.*

*calligramma*, *Dalm.*

*elegantula*, *Dalm.*

*protensa*, *Sow.*

*Strophomena corugatella*, *Dav.*

*grandis*, *Sow.*

*pecten*, *Linn.*

*rhomboidalis*, *Wilck.*

*Pentamerus oblongus*, *Sow.*

*Spirifera plicatella*, *Linn.*

*Raphiostoma elliptica*, *Hiz.*

*lenticularis*, *Sow.*

*Bellerophon acutus*, *Sow.*

*trilobatus*, *Sow.*

B. Fossils of the BLACK SHALE (*Moffat Series*).

<i>Coenograptus gracilis</i> , <i>Hall</i> .	<i>Diplograptus dentatus</i> , <i>Brongn</i> .
<i>surcularis</i> , <i>Hall</i> .	<i>foliaceus</i> , <i>Murch</i> .
<i>Climacograptus bicornis</i> , <i>Hall</i> .	<i>Hincksii</i> , <i>Hopk</i> .
<i>teretiusculus</i> , <i>His</i> .	<i>pristis</i> , <i>His</i> .
<i>Corynoides calicularis</i> , <i>Nich</i> .	<i>quadrimumcronatus</i> , <i>Hall</i> .
<i>Dicellograptus elegans</i> , <i>Carr</i> .	<i>tricornis</i> , <i>Carr</i> .
<i>Forchhammeri</i> , <i>Gein</i> .	<i>Whitfieldii</i> , <i>Hall</i> .
<i>Moffatensis</i> , <i>Carr</i> .	<i>Leptograptus flaccidus</i> , <i>Hall</i> .
<i>sextans</i> , <i>Hall</i> .	<i>Thamnograptus Barrandii</i> , <i>Hall</i> .
<i>Dicranograptus formosus</i> , <i>Hopk</i> .	<i>typus</i> , <i>Hall</i> .
<i>Nicholsoni</i> , <i>Hopk</i> .	<i>Discina Portlocki</i> , <i>Gein</i> .
<i>ramosus</i> , <i>Hall</i> .	<i>Siphonotreta micula</i> , <i>M'Coy</i> .
<i>Diplograptus angustifolius</i> , <i>Hall</i> .	

## GIRVAN DISTRICT.

The area embraced under this head is the south-western angle of Ayrshire, more generally known under its local title of *Carrick*. The greater portion of the district is the low pastoral table-land lying between the fertile valleys of the Girvan and Stinchar, and terminated abruptly seaward by a picturesque line of cliff. An isolated and much smaller area lies to the north of the former river in the cultivated slopes of Craighead and Mulloch. The district has long been famous, geologically, for the abundance and beauty of its Silurian fossils, but little is yet known with certainty regarding the sequence and equivalency of the containing beds. There can, however, but be little hesitation in regarding all except the lowest beds as constituting a fossiliferous portion of the great *Valentian* formation, into which, indeed, they dip everywhere on the south of the valley of the Stinchar. The facts gathered in the district itself point out a succession similar to that indicated in the following paragraphs:—

- (a) *Crystalline and metamorphic rocks* occupy a large extent of the fine coast-line between Girvan and Ballantrae, and stretch up into the country to the north-west. They consist of feldspathic rocks (amygdaloidal, porphyritic, brecciated, and crystalline), diorite, syenite, hypersthene, diallage-rock, and serpentine. They are all well exposed along the coast road, or in its immediate neighbourhood. Many of these beds are regarded by the Officers of the Geological Survey as metamorphosed Silurians, and the district has been instanced as one in which the various stages of metamorphism are apparent.
- (b) *Limestone*.—Lying in small patches amid the crystalline rocks, or apparently imbedded in the conglomerates next to be described, are local masses of fossiliferous limestone, destitute of stratification, white, and amorphous. It is well exhibited at Craighead, Aldons, Tramitshell, and at various localities in the valleys of the Assel and Stinchar.

Fossils are numerous but very difficult of extraction. The general grouping of forms is peculiar, but the majority are of Bala age.

#### LOWER GIRVAN SERIES.

- C<sup>1</sup>. *Conglomerates*.—These exhibit all the characters of those mentioned as occurring in the *Valentian* of Moffat, Leadhills, &c., but they are far more numerous geographically. The chief or lower conglomerate partly surrounds the metamorphic rocks and passes far up into the interior, usually in association with the limestone. It is made up of rounded masses (sometimes 4 feet in diameter) of grit, quartz, syenite, felstone, and metamorphic rocks, imbedded in a greenish or grayish matrix, sometimes so compact that “the casts of the pebbles remain after the stones themselves have fallen out, sometimes soft and earthy, when the rock becomes a mere uncompacted gravel.”
- C<sup>2</sup>. *Flagstones and Shales*, of great collective thickness, and containing, near the base of the group, some calcareous bands highly fossiliferous (Ardwell Shore, Ardmillan Braes, &c.). The higher bands are shaly flagstones, barren of everything but *Graptolites* and *Orthoceratites* (Shalloch Mill, Piedmont Glen, Penwhapple Glen, &c.). The bed at the summit of this sub-group is a soft shaly mudstone, containing numerous fossils in an exquisite state of preservation (Drummuck, Lady Burn, &c.).

#### UPPER GIRVAN SERIES.

- D<sup>1</sup>. *Conglomerate*.—This reposes immediately upon the bed last mentioned, and forms the base of the second group. It is of irregular thickness, and somewhat similar in its chief features to the conglomerate already described. It passes up by the gradual intercalation of gritty flags into the following beds (Kirk Hill).
- D<sup>2</sup>. *Mulloch Hill Sandstone*.—Red or greenish sandstones, sandy flagstones and shales, swarming with fossils, principally shells and casts of shells. These beds are admirably exposed in the small quarries on the sides of the road near the farm of High Mains (north-east of Girvan). They appear to come into the place of the Mayhill Sandstone of Siluria.

These are the highest visible Silurians to the north of the Girvan, and they are covered up at once by the Old Red Sandstone. Some highly fossiliferous beds on Saugh Hill and in Penwhapple Glen may belong to this upper group.<sup>1</sup>

#### Plantæ.

SPONGARIUM, *Milne Edwards*.  
aquistriatum, *M'Coy*.

Craig Head.

#### Amorphozoa.

ISCHADITES, *Kenig*.  
Koenigii, *Murch*.  
NIDULITES, *Salter*.  
favus, *Salter*.

Penkill.

Mulloch.

<sup>1</sup> Compare also Geol. Survey Scotland, Explan. Sheet VII. III.

## Hydrozoa.

MONOGRAPTUS, <i>Geinitz</i> .	
<i>colonus, Barr.</i>	Penwhapple Glen.
<i>concinnus, Lapw.</i>	Penwhapple Glen.
<i>prionon, Bronn.</i>	Penwhapple Glen.
<i>Salteri, Geinitz.</i>	Piedmont Glen.
<i>Sedgwickii, Portl.</i>	Penwhapple Glen.
<i>spinigerus, Nich.</i>	Penwhapple Glen.
CYTOGRAPTUS, <i>Carruthers.</i>	
<i>Grayæ, Lapw.</i>	Penwhapple Glen.
DICRANOGRAPTUS, <i>Hall.</i>	
<i>Nicholsoni, Hopk.</i>	Penwhapple Glen.
<i>ramosus, Hall.</i>	Letterpin.
DIPLOGRAPTUS, <i>M'Coy.</i>	
<i>foliaceus, Murch.</i>	Penkill.
<i>palmeus, Barr.</i>	Drummuck Burn.
<i>pristis, His.</i>	Piedmont Glen.
CLIMACOGRAPTUS, <i>Hall.</i>	
<i>bullatus, Salter.</i>	Craig Head.
RETIOLITES, <i>Barrande.</i>	
<i>Geinitzianus, Barr.</i>	Blair Farm.
DICTYONEMA, <i>Hall.</i>	
<i>sociale, Salter.</i>	Craigens.

## Actinozoa.

FAVOSITES, <i>Lamarck.</i>	
<i>alveolaris, Goldf.</i>	Mulloch.
<i>aspera, D'Orb.</i>	Mulloch.
HALYSITES, <i>Fischer.</i>	
<i>catenulatus, Linn.</i>	Penkill,
HELIOLITES, <i>Dana.</i>	
<i>favosus, M'Coy.</i>	Craig Head.
<i>inordinatus, Lonsd.</i>	Saugh Hill.
<i>interstinctus, Wahlen.</i>	Mulloch.
<i>megastoma, M'Coy.</i>	Mulloch.
<i>subtilis, M'Coy.</i>	Mulloch.
<i>tubulatus, Lonsd.</i>	Mulloch.
NEBULIPORA, <i>M'Coy.</i>	
<i>lens, M'Coy.</i>	Mulloch.
PETRAIA, <i>Münster.</i>	
<i>aequisulcata, M'Coy.</i>	Craig Head.
<i>bina, Lonsd.</i>	Mulloch.
<i>elongata, Phil.</i>	Craig Head.
<i>subduplicata, M'Coy.</i>	Mulloch.
STENOPORA, <i>Lonsdale.</i>	
<i>fibrosa, Goldf.</i>	Craig Head.
STREPHODES, <i>M'Coy.</i>	
<i>Craigensis, M'Coy.</i>	Craig Head.
ZAPHRENTIS, <i>Rafinesque.</i>	
<i>turbinata, Linn.</i>	Craig Head.

**Echinodermata.**

- GLYPTOCRINUS, *Hall*.  
*basalis*, *M'Coy*. Penwhapple Glen.

**Annelida.**

- CHONDRITES, *Sternberg*.  
*verisimilis?* *Salter*. Bargany Pond.  
 CROSSOPODIA, *M'Coy*.  
*Scotica*, *M'Coy*. Penkill.  
 SERPULITES, *MacLeay*.  
*longissimus*, *Murch*. Drummuck.  
 TENTACULITES, *Schlotheim*.  
*Anglicus*, *Salter*. Craigens.  
*annulatus*, *Schloth*. Mulloch.

**Cirripedia.**

- PLUMULITES, *Barrande*.  
*sp.* Balclethie,

**Crustacea.—I. Trilobita.**

- ACIDASPIS, *Murchison*.  
*Brightii*, *Murch*. Penkill.  
*callipareos*, *Wyv. Thoms*. Mulloch.  
*hystrix*, *Wyv. Thoms*. Penwhapple Glen.  
*Lalage*, *Wyv. Thoms*. Penwhapple Glen.  
 AGNOSTUS, *Brongniart*.  
*trinodus*, *Salter*. Balclethie.  
 AMPYX, *Dalman*.  
*latus*, *M'Coy*. Balclethie.  
*mammillatus*, *Sars*. Penwhapple Glen.  
*nasutus*, *Dalm*. Penwhapple Glen.  
*nudus*, *Murch*. Balclethie.  
*Portlockii*, *Barr*. Drummuck.  
*rostratus*, *Sars*. Drummuck.  
 ASAPHUS, *Brongniart*.  
*gigas*, *De Kay*. Ardmillan Braes.  
*nobilis*, *Barr*. Balclethie.  
*rectifrons*, *Portl*. Ardmillan Braes.  
 BRONTEUS, *Goldfuss*.  
*Brongniarti*, *Barr*. Penkill.  
*Hibernicus*, *Portl*. Penwhapple Glen.  
 CALYMENTE, *Brongniart*.  
*Blumenbachii*, *Brongn*. Drummuck.  
*tuberculosa*, *Salter*. Drummuck.  
 CHEIRURUS, *Beyrich*.  
*bimucronatus*, *Murch*. Drummuck.  
*clavifrons*, *Dalm*. Drummuck.  
*gelasinus*, *M'Coy*. Craig Head.  
*octolobatus*, *M'Coy*. Penwhapple Glen.  
*trispinosus*, *Dr. J. Young*. Penkill.

CYBELE, <i>Lovén.</i>	
<i>rugosa, Portl.</i>	Drummuck.
<i>verrucosa, Dalm.</i>	Penwhapple Glen.
CYPHASPIS, <i>Burmeister.</i>	
<i>megalops, M'Coy.</i>	Drummuck.
DEIPHON, <i>Barrande.</i>	
<i>Forbesii, Barr.</i>	Balcletchie.
ENCERINURUS, <i>Emmerich.</i>	
<i>punctatus, Brönn.</i>	Penkill.
<i>variolaris, Brönn.</i>	Penkill.
ILÆNUS, <i>Dalman.</i>	
<i>Barriensis, Murch.</i>	Drummuck.
<i>Bowmanni, Salter.</i>	Balcletchie.
<i>crassicauda, Wahl. ?</i>	Knockdolian.
<i>Davisi, Salter.</i>	Aldons.
<i>Maccallumi, Salter.</i>	Drummuck.
<i>nexilis, Salter.</i>	Mulloch.
<i>Rosenbergii, D'Eichwald.</i>	Mulloch.
<i>Thomsoni, Salter.</i>	Penkill.
LICHAS, <i>Dalman.</i>	
<i>avus, Barr.</i>	Craig Head.
<i>laxatus, M'Coy.</i>	Mulloch.
PHACOPS, <i>Emmerich.</i>	
<i>Brongniarti, Portl.</i>	Ardmillan Braes.
<i>Dalmanni, Portl.</i>	Ardmillan Braes.
<i>Downingiae, Murch.</i>	Mulloch.
<i>Stokesii, M. Edw.</i>	Mulloch.
PROETUS, <i>Steininger.</i>	
<i>latifrons, M'Coy.</i>	Drummuck.
REMOPLEURIDES, <i>Portlock.</i>	
<i>dorso-spinifer, Portl.</i>	Drummuck.
SALTERIA, <i>Wyr. Thomson.</i>	
<i>primæva, Wyr. Thoms.</i>	Balcletchie.
STAUROCEPHALUS, <i>Barrande.</i>	
<i>globiceps, Portl.</i>	Ardmillan Braes.
<i>? unicus, Wyr. Thoms.</i>	Balcletchie.
STYGINA, <i>Salter.</i>	
<i>latifrons, Salter.</i>	Ardmillan Braes.
TRINUCLEUS, <i>Lhwyd.</i>	
<i>Bucklandi, Barr.</i>	Drummuck.
<i>fimbriatus, Murch.</i>	Drummuck.
<i>seticornis, His.</i>	Drummuck.

## Crustacea.—II. Ostracoda and Phyllopoda.

BEYRICHIA, <i>M'Coy.</i>	
<i>impedens, Jones.</i>	Blair Farm.
<i>Klœdeni, M'Coy.</i>	Blair Farm.
CYTHERE, <i>Müller.</i>	
<i>Aldensis, M'Coy.</i>	Aldons.

<b>PRIMITIA</b> , <i>Jones and Holl.</i>	
<i>M'Coyii</i> , <i>Salter.</i>	Aldons.
<b>SOLENOCARIS</b> , <i>Dr. J. Young.</i>	
<i>solenoides</i> , <i>Dr. J. Young.</i>	Balcletchie.

**Polyzoa.**

<b>PTILODYCTIA</b> , <i>Lonsdale.</i>	
<i>costellata</i> , <i>M'Coy.</i>	Mulloch.
<i>dichotoma</i> , <i>Portl.</i>	Balcletchie.

**Brachiopoda.**

<b>ATREYA</b> , <i>Dalman.</i>	
? <i>hemisphaerica</i> , <i>J. de C. Sow.</i>	Penkill.
<i>imbricata</i> , <i>J. de C. Sow.</i>	Penkill.
? <i>incerta</i> , <i>Dav.</i>	Penkill.
<i>reticularis</i> , <i>Linn.</i>	Penkill.
? <i>Scotica</i> , <i>M'Coy.</i>	Mulloch.
<b>DISCINA</b> , <i>Lamarck.</i>	
<i>crassa</i> , <i>Hall.</i>	Penwhapple Glen.
<i>oblongata</i> , <i>Portl.</i>	Drummuck.
<i>perrugata</i> , <i>M'Coy.</i>	Balcletchie.
<b>LEPTAENA</b> , <i>Dalman.</i>	
<i>quinquecostata</i> , <i>M'Coy.</i>	Craig Head.
<i>sericea</i> , <i>Sow.</i>	Craig Head.
<i>var. rhombica</i> , <i>M'Coy.</i>	Craig Head.
<i>tenuicincta</i> , <i>M'Coy.</i>	Balcletchie.
<i>transversalis</i> , <i>Wahl.</i>	Craig Head.
<i>var. Youngiana</i> , <i>Dav.</i>	Craig Head.
<b>LINGULA</b> , <i>Bruguière.</i>	
<i>attenuata</i> , <i>Sow.</i>	Balcletchie.
<i>quadrata</i> , <i>D'Eichwald.</i>	Craig Head.
<i>Ramsayi</i> , <i>Salter.</i>	Balcletchie.
<b>MERISTELLA</b> , <i>Hall.</i>	
<i>angustifrons</i> , <i>M'Coy.</i>	Mulloch.
<b>ORTHIS</b> , <i>Dalman.</i>	
<i>Actoniæ</i> , <i>Sow.</i>	Craig Head.
<i>biforata</i> , <i>Schloth.</i>	Craig Head.
<i>Bouchardii</i> , <i>Dav.</i>	Craig Head.
<i>calligramma</i> , <i>Dalm.</i>	Craig Head.
<i>confinis</i> , <i>Salter.</i>	Mulloch.
<i>elegantula</i> , <i>Dalm.</i>	Craig Head.
<i>Girvanensis</i> , <i>Dav.</i>	Craig Head.
<i>intercostata</i> , <i>Portl.</i>	Aldons.
<i>plicata</i> , <i>Sow.</i>	Craig Head.
<i>reversa</i> , <i>Salter</i> , <i>var.</i> <i>Mulloch-</i>	
<i>iensis</i> , <i>Dav.</i>	Mulloch.
<i>tricenaria</i> , <i>Conrad.</i> (?)	Piedmont Glen.
<i>turgida</i> , <i>M'Coy.</i>	Craig Head.
<i>unguis</i> , <i>Sow</i> , <i>sp.</i>	Craig Head.
<i>vespertilio</i> , <i>J. de C. Sow.</i>	Craig Head.



<b>PENTAMERUS, Fischer.</b>	
oblongus, <i>J. de C. Sow.</i>	Penwhapple Glen.
rotundatus, <i>Sow.</i>	Penwhapple Glen.
<b>REYNCHONELLA, Fischer.</b>	
semula, <i>Salter.</i>	Craig Head.
borealis, <i>Salter.</i>	Craig Head.
cuneata, <i>Dalm.</i>	Mulloch.
Llandoveriana, <i>Dav.</i>	Saugh Hill.
nasuta, <i>M'Coy.</i>	Craig Head.
Salteri, <i>Dav.</i>	Craig Head.
Thomsoni, <i>Dav.</i>	Craig Head.
Weaveri, <i>Salter.</i>	Craig Head.
<b>SIPHONOTRETA, De Verneuil.</b>	
micula, <i>M'Coy.</i>	Balcletchie.
sp.	Craig Head.
<b>SPIRIFERA, Sowerby.</b>	
elevata, <i>Dalm.</i>	Balcletchie.
<b>STRIKLANDINIA, Billings.</b>	
lens (?), <i>Sow.</i>	Balcletchie.
<b>STROPHOMENA, Rafinesque.</b>	
antiquata, <i>Sow.</i>	Penkill.
applanata, <i>Salter.</i>	Penkill.
corrugatella, <i>Dav.</i>	Balcletchie.
deltoidea, <i>Conrad.</i>	Balcletchie.
expansa, <i>Sow.</i>	Mulloch.
grandis, <i>Sow.</i>	Thraive Glen.
Grayiæ, <i>Dav.</i>	Craig Head.
imbrex, <i>Pander, var. semiglobosa, Dav.</i>	Craig Head.
pecten, <i>Linn.</i>	Mulloch.
? retroflexa, <i>Salter.</i>	Craig Head.
rhomboidalis, <i>Wilck.</i>	Penkill.
<b>TRIPLESIA, Hall.</b>	
Grayiæ, <i>Dav.</i>	Craig Head.

**Lamellibranchiata.***Monomyaria.*

<b>PTERINEA, Goldfuss.</b>	
pleuroptera, <i>Conrad.</i>	Knockgardner.
Sowerbyi, <i>M'Coy.</i>	Mulloch.

*Dimyaria.*

<b>ARCA, Linné.</b>	
Edmondiaformis, <i>M'Coy.</i>	Ardmillan Braes.
<b>CARDIOLA, Broderip.</b>	
fibrosa, <i>Sow.</i>	Blair Farm.
striata, <i>Sow.</i>	Mulloch.
<b>CONOCARDIUM, Bronn.</b>	
dipterum, <i>Salter.</i>	Craig Head.

<b>CTENODONTA</b> , <i>Salter</i> .	
<i>levata</i> , <i>Hall</i> .	Balcletchie.
<b>CYPRICARDIA</b> , <i>Lamarck</i> .	
<i>simplex</i> , <i>Portl</i> .	Mulloch.
<b>MODIOLOPSIS</b> , <i>Hall</i> .	
<i>modiolaris</i> , <i>Conrad</i> .	Ardmillan Braes.
<b>MYTILUS</b> , <i>Linné</i> .	
<i>mytilimeris</i> , <i>Conrad</i> .	Penkill.
<b>ORTHONOTA</b> , <i>Conrad</i> .	
<i>semisulcata</i> , <i>Sow</i> .	Penkill.
<i>truncata</i> , <i>M'Coy</i> .	Knockgardner.

**Gasteropoda.**

<b>ACROCULIA</b> , <i>Phillips</i> .	
<i>haliotis</i> , <i>Sow</i> .	Cuddystone Glen.
<b>CYCLONEMA</b> , <i>Hall</i> .	
<i>crebristria</i> , <i>M'Coy</i> .	Ardmillan Braes.
<b>HOLOPELLA</b> , <i>M'Coy</i> .	
<i>obsoleta</i> , <i>Sow</i> .	Drummuck.
<i>tenuicincta</i> , <i>M'Coy</i> .	Mulloch.
<b>LOXONEMA</b> , <i>Phillips</i> .	
<i>elegans</i> , <i>M'Coy</i> .	Drummuck.
<b>MACROCHEILUS</b> , <i>Phillips</i> .	
<i>elongatus</i> , <i>Portl</i> .	Kirk Hill.
<b>MURCHISONIA</b> , <i>D'Archiac et de Verneuil</i> .	
<i>angustata</i> , <i>Hall</i> .	Knockdolian.
<i>bicincta</i> , <i>M'Coy</i> .	Drummuck.
<i>cancellatula</i> , <i>M'Coy</i> .	Mulloch.
<i>elongata</i> , <i>Portl</i> .	Mulloch.
<i>gyrogonia</i> , <i>M'Coy</i> .	Penwhapple Glen.
<i>obscura</i> , <i>Portl</i> .	Balcletchie.
<i>pulchra</i> , <i>M'Coy</i> .	Drummuck.
<i>scalaris</i> , <i>Salter</i> .	Aldons.
<i>simplex</i> , <i>M'Coy</i> .	Mulloch.
<b>OPHILETA</b> , <i>Vanuxem</i> .	
<i>compacta</i> , <i>Salter</i> .	Penwhapple Glen.
<b>PLEUROTOMARIA</b> , <i>DeFrance</i> .	
<i>Moorei</i> , <i>Salter</i> .	Mulloch.
<b>SCALITES</b> , <i>Conrad</i> .	
<i>angulatus</i> , <i>Hall</i> .	Penkill.
<b>RAPHIOSTOMA</b> , <i>Hall</i> .	
<i>æqualis</i> , <i>Salter</i> .	Penwhapple Glen.
<i>lenticularis</i> , <i>Sow</i> .	Craig Head.
<i>striatula</i> , <i>Hall</i> .	Penwhapple Glen.
<b>TROCHONEMA</b> , <i>Salter</i> .	
<i>latifasciata</i> , <i>M'Coy</i> .	Aldons.
<i>tricincta</i> , <i>M'Coy</i> .	Mulloch.
<b>TROCHUS</b> , <i>Linné</i> .	
<i>helicites</i> , <i>Sow</i> .	Mulloch.

**Pteropoda and Heteropoda.****BELLEROPHON, Montfort.**

*acutus, Sow.*  
*bilobatus, Sow.*  
*carinatus, Sow.*  
*dilatatus, Sow.*  
*expansus, Sow.*  
*falcatus, Salter.*  
*perturbatus, Sow.*  
*subdecussatus, M'Coy.*  
*trilobatus, Sow.*  
*Wenlockensis, Sow.*

Drummuck.  
 Drummuck.  
 Drummuck.  
 Mulloch.  
 Drummuck.  
 Drummuck.  
 Drummuck.  
 Mulloch.  
 Drummuck.  
 Drummuck.

**CONULARIA, Miller.**

*elongata, Portl.*  
*Sowerbyi, Murch.*  
*sp.*

Balcletchie.  
 Thraive Glen.  
 Balcletchie.

**ECOLIOMPHALUS, Portlock.**

*Bucklandi, Portl.*  
*Sooticus, M'Coy.*

Ardmillan Braes.  
 Mulloch.

**MACLUREA, Emmons.**

*Logani, Salter.*  
*Maccayi, Salter.*  
*macromphala, M'Coy.*  
*magna, Lesueur.*

Pinmacher.  
 Aldons.  
 Craig Head.  
 Aldons.

**PTEROTHECA, Salter.**

*corrugata, Salter.*

Drummuck.

**STENOTHECA, Salter.**

*sp.*

Penkill.

**THECA, Sowerby.**

*reversa, Salter.*  
*triangularis, Portl.*  
*vaginula, Salter.*

Ardmillan Braes.  
 Drummuck.  
 Ardmillan Braes.

**Cephalopoda.****CYETOCERAS, Goldfuss.**

*multicameratum, Hall.*  
*subarcuatum, Etheridge.*

Knockdolian.  
 Piedmont Glen.

**LITUITES, Breynius.**

*cornu-arietis, Sow.*

Penwhapple Glen.

**ORTHO CERAS, Breynius.**

*angulatum, Wahl.*  
*Barrandei, Salter.*  
*bilineatum, Hall.*  
*calamiteum, Münster.*  
*canaliculatum, Sow.*  
*filosum, Sow.*  
*ibex, Sow.*  
*imbricatum, Wahl.*  
*politum, M'Coy.*  
*subgregarium, M'Coy.*  
*subundulatum, Portl.*

Ardwell.  
 Mulloch.  
 Penwhapple Glen.  
 Ardwell.  
 Penwhapple Glen.  
 Drummuck.  
 Ardmillan Braes.  
 Ardmillan Braes.  
 Craig Head.  
 Drummuck.  
 Blair Farm.

Orthoceras— <i>continued.</i>	
tenuistriatum, <i>Minst.</i>	Mulloch.
vaginatum, <i>Schloth.</i>	Ardwell.
PHRAGMO CERAS, <i>Broderip.</i>	
compressum, <i>Sow.</i>	Penkill.

## CHIEF LOCALITIES FOR FOSSILS.

## ALDONS, 5 miles S. of Girvan.

Quarry section. White or grayish compact limestone in massive beds, associated with conglomerates. Fossils are abundant. *Maclurea Maccoyi*, and *M. magna* are found here.

## ARDMILLAN BRAES, 2½ miles S.W. of Girvan.

Natural section of calcareous shale amid the hard flaggy shales and flagstones. Fossils numerous. *Phacops Brongniarti*, *P. Dalmanni*, *Staurocephalus globiceps*, and *Stygina latifrons* are among the trilobites quoted from this locality.

## ARDWELL SHORE, 3 miles S.W. of Girvan.

Flaggy shales and flagstones, nearly vertical, containing Graptolites and Orthoceratites.

## BALCLETCHIE, 4 miles E. by S. of Girvan. Shivery mudstones, highly fossiliferous.

The following may be noted as among the more important forms: *Acidaspis hystrix*, *A. Lalage*, *Agnostus trinodus*, *Asaphus nobilis*, *Deiphon Forbesi*, *Ilanus Bonmanni*, *Staurocephalus unicus*, *Salterella primæva*, *Plumulites*, sp., *Solenocaris solenoides*, *Discina ferrugata*, *Lingula Ramsayi*, *Spirifer elevata*, *Strophomena corrugata*, and *S. deltoidea*.

## BARBÆ, 3 miles S.E. of Girvan.

Natural section of mudstones, shales, and sandstones. Few fossils are recorded.

## BLAIR FARM, 8½ miles N.E. of Girvan.

Green, gray, and yellow shales, with bands of greywacke exposed in quarry between Shiel Burn and the farmhouse. *Retiolites Geinitziensis*, two species of *Beyrichia*, *Cardiola fibrosa*, and *Orthoceras subundulatum* occur at this locality, but fossils, it is reported, are neither abundant nor in good preservation.

## CAMREGAN PLANTATION, 2 miles E. of Girvan.

Similar section to that at Barbæ.

## CRAIG HEAD QUARRY, 3 miles N.E. of Girvan and ¼ mile from Killochan Railway Station.

Limestone, gray and compact, containing serpentine, and associated with greenish shales and conglomerate. At some places the limestone is altered into serpentine. Fossils are abundant, but difficult of extraction. The following are some of the more notable forms: *Spongarium equistriatum*, *Heliolites favosus*, *Petraia*, *Tentaculites Anglicus*, *Encrinurus punctatus*, *Lichas avus*?, *Leptæna transversalis*, *Lingula quadrata*, *Orthis Adonia*, *O. Girvanensis*, *Rhynchonella Weveri*, *R. Salteri*, *Strophomena deltoidea*, *Triplexia Grayia*, *Conocardium dipterum*, and *Madurea macromphala*.

## DRUMMUCK BURN, 4 miles N.E. of Girvan.

Brownish mudstones, containing numerous fossils in excellent preservation.

## KNOCKGARDNER, 10 miles N.E. of Girvan.

Silurian shales and grits with porphyry (Greenhill of Knockgardner); Old Red Sandstone with diorites and porphyries. A few fossils are recorded from a quarry on roadside.

## LADY BURN, above Drummuck.

Mudstones in burn section, containing numerous well-preserved fossils.

**LETTERPIN, 4 miles S. of Girvan.**

Natural sections of limestone, a possible continuation of that at Aldons.

**MULLOCH HILL, 4½ miles N.E. of Girvan.**

Various quarry sections on roadside exposing Llandovery rocks, consisting of conglomerates passing up into brown or yellow flagstones, sandy or siliceous, with yellowish shales. There is no apparent unconformity. The fossils are very abundant, but casts chiefly.

**PENKILL, 3½ miles N.E. of Girvan.**

The following are some of the fossils which have been collected at this locality: *Ischadites Kerrigii*, *Halyites catenulatus*, *Crossopodia Scotica*, *Bronteus Brongniartii*, *Enerinurus variolarius*, *Ilanus Thomsoni*, four species of *Atrypa*, and various other Brachiopoda. *Orthonota semisulcata*, and *Mytilus mytilimeris*.

**PENWHAFFLE GLEN, E. by S. of Girvan.**

Graptolite shales, with hard greywacke and breccia, in burn sections. Fossils are abundant in certain places.

**PIEDMONT GLEN, S. of Girvan.**

Hard shales in burn section containing Graptolites and Orthoceratites. Few fossils recorded from this locality.

**PINMAHER, 2¼ miles S. of Girvan.**

Natural sections of limestone same as at Aldons and Letterpin.

**SAUGH HILL, 1½ miles E. by S. of Girvan.**

Fine micaceous dark gray sandstones in natural sections, very fossiliferous.

**TRAMITCHELL, 3 miles S.E. of Girvan.**

Similar group to that at Camregan.

**LESMAHAGOW DISTRICT.**

(Geol. Survey of Scotland, Explanation to Sheet 23.)

IN this district the Upper Silurian rocks occupy an area of about 10 square miles, and consist of gray sandstones, gray, flaggy, and sandy shales, blue shale, and hard bands of greywacke. The sandy beds are found near the top of the series; these pass down into finely lœvigated blue and gray shales, in places calcareous, and further down these get split up into bands of hardened sandstone or greywacke, often weathering with a yellowish ochreous crust. All these rocks form part of a great anticline, the southern extension of which, however, is greatly obscured by intrusive sheets and dykes of felstone and basalt-rock, and abruptly truncated by a large fault, which in places brings down a quartz-rock conglomerate against some of the lowest members of the series, the fault having in such places a downthrow of not less than 3000 feet. It is along their north-western margin that the beds are best studied, as they there lie more regularly and pass up conformably into the overlying Old Red Sandstone, while they dip to the north-west with an average angle of 20°, except at their southern extremity, where they are considerably steeper.

The following table shows their mode of occurrence at the north-eastern end of the area, beginning at the uppermost beds and passing downwards:—

## TABLE OF THE UPPER SILURIAN ROCKS IN THE LESMAHAGOW DISTRICT.

6. Sandy, flaggy, and green sandy bands and shales, with partings of gray and red mudstone, passing conformably upwards into the Lower Old Red Sandstone, about 130 feet.
5. Blue, gray, and green shales, sandy mudstones, and sandstone bands, becoming more shaly and flaggy towards the bottom, 200 feet (*Trochus* beds).
4. Hard, blue, and gray flaggy shales, with occasional bands of calcareous nodules, 350 feet (*Pterygotus* beds).
3. Hard gray flagstones, and bands of hard greywacke, about 500 feet.
2. Gray, blue, and olive shales, becoming more or less interbedded with hard-stone bands towards the base, about 300 feet.
1. Hard bands of of greywacke with shale partings. These form the lowest portion of the Upper Silurian rocks visible. They must be at least 2000 feet thick.

Good sections of Nos. 5 and 6 are seen wherever a watercourse is found cutting across the boundary line between the Lower Old Red Sandstone and the Upper Silurian rocks, as in Lochfennoch, Blaeberry and Leaze Burns, and in a small ravine near Waterhead, and at Linburn. The Logan Water, a little above Dunside, exposes the best section of band No. 4, and it is there that the most perfect specimens of *Pterygotus* and its allies have been found. The band does not seem to extend further to the south-west than the Leaze Burn. No. 3 is exposed in the Logan Water above Logan House, and in the Leaze Burn. No. 2 is seen at the head of the Birkenhead Burn, in the Long Burn near Logan House, and also in the Leaze Burn. No. 1 skirts the southern boundary of the area, and is met with in all the streams from Eaglinside Burn to Hall on the Greenock Water.

## CHIEF LOCALITIES FOR FOSSILS.

## LESMAHAGOW DISTRICT.

Birkenhead Burn, Logan Water, 3 miles S.W. of Lesmahagow.  
 Blaeberry Burn, Logan Water, 5½ miles S.W. of do.  
 Burn, W. of Dunside, 4 miles S.W. of do.  
 Eaglinside Burn, River Nethan, 4½ miles S.W. of do.  
 Kip Burn, Logan Water, 6 miles S.W. of do.  
 Logan Water, at Dunside, 4 miles S.W. of do.  
     Do. near top, 2 miles S. of Dunside.  
     Do. about 250 yards below greenstone dyke, 6 miles S.W. of Lesmahagow.  
 Long Burn, Logan Water, near Logan House, 5½ miles S.W. of Lesmahagow.

## MUIRKIRK DISTRICT.

Douglas Water, 5 miles E. of Muirkirk.  
 Forkings, Quarry on Roadside at, 2 miles N.W. of Muirkirk.  
 Lann Burn, little streamlet E. of,  $1\frac{1}{2}$  miles N.W. of do.  
 Do. a little above Lamornburn Ruins, about  $1\frac{1}{2}$  miles N.E. of Muirkirk.  
 Do. near top,  $1\frac{1}{2}$  miles N.E. of Muirkirk.  
 Leaze Burn, near top, near Priest Hills.  
 Linburn, 2 miles N. of Muirkirk.  
 Priest Hills, Escarpment about  $1\frac{1}{2}$  miles E. of, 2 miles N.E. of Muirkirk.  
 Waterhead, Greenock Water, Burn  $1\frac{1}{2}$  miles E. of,  $2\frac{1}{2}$  miles N. of do.

## DOUGLAS DISTRICT.

High Broomerside, burn near,  $2\frac{1}{2}$  miles W. by S. of Douglas.

## FOSSILS COLLECTED FROM THE FOREGOING LOCALITIES.

## Annelida.

SPIROBIS, *Lamarck*.  
*Lewisii*, *Sow*.

Blaeberry Burn.

## Crustacea.

BEYRICHTIA, *M'Coy*.  
*Kloedeni*, *M'Coy*.

Blaeberry Burn.

CERATTOCARIS, *M'Coy*.  
*papilio*, *Salter*.  
*stygius*, *Salter*.

Logan Water.  
 Kip Burn.

DICTYOCARIS, *Salter*.  
*Slimoni*, *Salter*.

Blaeberry Burn; Nethan and Logan Water.

EURYPTERUS, *Dekay*.  
*lanceolatus*, *Salter*.  
*obesus*, *H. Woodw.*  
*scorpoides*, *H. Woodw.*

Kip Burn; Logan Water.  
 Logan Water.  
 Logan Water.

NEOLIMULUS, *H. Woodward*.  
*falcatus*, *H. Woodw.*

Logan Water.

PTERYGOTUS, *Agassiz*.  
*bilobus*, *Salter*.

*var. inornatus*, *H. Woodw.* Logan Water and Burn west of Dunside.

*var. accidens*, *H. Woodw.* Do. do.

*var. crassus*, *H. Woodw.* Do. do.

*var. perornatus*, *H. Woodw.* Do. do.

*raniceps*, *H. Woodw.*

Blaeberry Burn.

SLIMONIA (Page), *H. Woodward*.  
*acuminata*, *Salter*.

Kip Burn; Logan Water; Nethan Water; Eaglinside Burn.

STYLONURUS (Page), *H. Woodward*.  
*Logani*, *H. Woodw.*

Logan Water.

## Brachiopoda.

Lingula minima, *Sow*.

Blaeberry Burn.

- Rhynchonella, sp., *Dav. (Mon. Sil. Brach.*  
*Lesmahagow*, Pl. iii. figs. 16, 16<sup>a</sup>). Parishholm, Douglas.  
 Strophomena rhomboidalis, *Wilck.* High Broomerside.

## Lamellibranchiata.

- |                                     |                 |
|-------------------------------------|-----------------|
| Goniophora cymbæformis, <i>Sow.</i> | Waterhead.      |
| Modiolopsis complanata, <i>Sow.</i> | Waterhead.      |
| Nilssoni, <i>His.</i>               | Blaeberry Burn. |
| Orthonota impressa, <i>Sow.</i>     | Waterhead.      |
| rotundata, <i>Sow.</i>              | Waterhead.      |
| solenoides, <i>Sow.</i>             | Waterhead.      |

## Gasteropoda.

- |   |                  |
|---|------------------|
| Acroculia antiquata, <i>Salter.</i>       |                  |
| Turbo (Platychisma) helicitæ, <i>Sow.</i> | Blaeberry Burn.  |
| simulans, <i>Salter.</i>                  | Birkenhead Burn. |

## Pteropoda.

- |                                |            |
|--------------------------------|------------|
| Theca Forbesii, <i>Sharpe.</i> | Lann Burn. |
|--------------------------------|------------|

## Cephalopoda.

- |                                      |               |
|--------------------------------------|---------------|
| Orthoceras gracile, <i>Portlock.</i> | Nethan Water. |
| tubicinella, <i>Sow.</i>             | Nethan Water. |

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## OLD RED SANDSTONE.

The Old Red Sandstone of the central, southern, and western districts of Scotland is singularly unfossiliferous, there being only two or three localities where remains of organisms have been found. In none of the limestones of the system, which are mostly of a dolomitic character, have any traces of fossils been detected. This unfossiliferous character is no doubt due to the mineral composition of the strata, and to the conditions under which it was deposited, these being seemingly unfavourable to the growth and development of the life of the period, as well as to their after preservation. The strata, which are believed to have been deposited in inland seas, which afterwards freshened into great lakes, consist of beds of sandstone of various colours, passing from a grayish-white into deep red and purple tints, often of a flaggy texture, and alternating with coarse beds of conglomerates made up of rolled pebbles of the older rocks.

The following list shows what fossils have been found, and the localities whence they have been obtained:—

**Plantæ.**

In a paper "On the Discovery of Plants in the Lower Old Red Sandstone in the Neighbourhood of Callander," communicated to the Geological Society of London on 21st June, 1876, Messrs. R. L. Jack and R. Etheridge, jun., of the Geological Survey of Scotland, quote the following localities where they had recently discovered plant-remains, viz., Buchanan Castle Quarry, near Drymen; Old Quarry at small reservoir near Kilmahew; Quarry in Cameron Plantation, near Alexandria; and Turnpike Road at Over-Balloch, Loch Lomond. The plants described in their paper are referred with doubt to the genus *Psilophyton* of Dawson.

**Hydrozoa.****GRAPTOLITHUS, sp.**

Carmichael Burn, at Manse,  $4\frac{1}{2}$  miles S.E. of Lanark, in a greenish-gray flaggy shale (*Geol. Surv. of Scot.*, Expl. to Sheet 23).

**Crustacea.****DITHYROCARIS (?) STRIATA, R. Etheridge, jun.**

At same locality, the anterior half of a carapace (*Geol. Surv. of Scot.*, Expl. Sheet 23, p. 100).

Traces of *Beyrichia* (?) have also been noticed at this locality by Professor Geikie.

**Cephalopoda.****ORTHOCERAS DIMIDIATUM, Sow.**

At same locality. This species is stated to be a common form in the Downton beds of the West of England.

**Pisces.****CEPHALASPIS, *Agassiz*.**Lyelli, *Ag.*

Tulloch, near Lanfine, Sorn district of Ayrshire, in pinkish-gray flagstones. Lower (!) Old Red Sandstone.

**PTERICHTHYS, *Agassiz*.**major, *Ag.*

Heads of Ayr, in red micaceous flagstones on the beach.

## THE CARBONIFEROUS FOSSILS OF CENTRAL AND WESTERN SCOTLAND.

The following remarks illustrate the mode of occurrence, condition, and nature of the deposits in which the several groups of Carboniferous fossils are found in the strata of the coal-fields of central and western Scotland as contained in the following list.

The several divisions of the Carboniferous system in the above-mentioned tract of country embrace a thickness of strata of nearly 5000 feet, exclusive of the underlying Calciferous Sandstone series, which consists of a great group of contemporaneous bedded traps that rest on strata of sandstone, impure dolomitic limestones, and marly shales. The thickness of these Lower Carboniferous traps and underlying strata is estimated as varying from 1500 to 2000 feet. They in their turn rest upon members of the Old Red Sandstone series, which occupy the district between the Carboniferous and Silurian formations.

In the coal-fields of the West of Scotland, the whole of the economic group of limestones, ironstones, sandstones, and coals lies in many instances over the traps of the Calciferous Sandstone series, these traps forming the floor on which the strata of the Lower Marine Limestone group were subsequently deposited.

In descending series the several divisions of our Carboniferous system and nature of the strata may be roughly tabulated as follows:—

**UPPER COALS AND IRONSTONES.**—This group of strata comprises a series of beds varying in thickness from 250 to 300 fathoms, including the upper red sandstone that overlies the workable coals. It consists, in its upper division, of beds of red sandstone, reddish-gray sandy shales, gray fire-clays, dark-gray shales, grayish-white sandstones, and one or two irregular thin beds of coal; in its middle and lower divisions, of white and grayish-white sandstones, dark-gray sandy clay-shales, fire-clays, and bituminous shales, in which occur, at intervals, strata of clay and blackband ironstone, with numerous seams of coal, many of which are workable.

The fossils indicate that brackish and fresh-water conditions have prevailed during the deposition of the strata, as only in one or two instances, and on widely separated horizons, have indications of marine or Carboniferous Limestone types of fossils been found. The characteristic organisms of this upper group consist of reptiles, fishes, shells, crustaceans, and plant-remains.

**MILLSTONE GRIT SERIES.**—This division is not distinguished by any well-marked lithological character, or series of economic beds. It is represented by a group of strata lying between the slaty-band ironstone and the Upper Limestone series, varying from 80 to 150 fathoms in thickness. It consists of thick-bedded sandstones, sandy shales and fire-clay, in which occur some

irregular beds of limestone and clay ironstone. The strata have been little explored, and the few fossils they have yielded do not seem to differ from those met with in the underlying limestone series.

**UPPER LIMESTONE SERIES.**—The strata of this division consist of several well-defined beds of calm, shelly, and impure limestone, calcareous shale, dark-gray aluminous shale, clay ironstone, thick-bedded white sandstone, and one or two workable beds of coal. The series averages from 80 to 100 fathoms in thickness. The organic remains are numerous, and consist of Plants, Foraminifera, Corals, Crinoids, Crustacea, Polyzoa, shells, and fish-remains.

**LOWER COALS AND IRONSTONES.**—This group, although occurring in the middle of the limestone series, is nevertheless closely related in its lithological and in several of its palæontological characters to the strata of the Upper Coal Measures. It varies from 70 to 100 fathoms in thickness, and consists of dark-gray, bituminous, and sandy shales, fire-clay, thick-bedded white sandstone, numerous bands of clay ironstone, several thin beds of free and cannel coal, some of which are wrought in connection with the blackband ironstones of the series. The fossils consist of fishes, shells, crustaceans, and plant-remains, several of the genera and species of which are recurrent in the Upper Coal Measures. Marine Limestone types of fossils have been met with only in one or two widely-separated horizons, and are local in their distribution.

**LOWER LIMESTONE SERIES.**—This lower division of the limestone series varies in thickness, in the West of Scotland, from 100 to more than 200 fathoms. In its lithological character it is somewhat similar to that of the Upper Limestone. At Beith, in Ayrshire, some of the beds of limestone attain a thickness of more than 40 feet, but in general they are much thinner. One or two workable beds of coal, and numerous bands of clay ironstone, occur in several horizons of the strata. In some districts, as at Campsie, thin beds of estuarine, or fresh-water limestone, containing Ostracoda and other organisms belonging to species that occur in the Upper Coal Measures, alternate with the coal beds and Marine Limestone. The fossils of the marine limestones and shales are numerous, and consist of Plants, Foraminifera, Sponges, Corals, Crinoids, Crustacea, Polyzoa, shells, and fish-remains.

**CALCIFEROUS SANDSTONE SERIES.**—The strata of this group consist, in the upper division, of a great thickness of bedded traps and ash beds, in which occur on one or two horizons, in the Campsie and Kilpatrick range of hills, intercalated strata of sandstone, impure beds of coal, and shale inclosing plant and fish remains. These traps rest conformably on the group of strata known as the Ballagan Limestone series, which consists of grayish-white sandstones, numerous alternations of impure dolomitic limestones and marly shales, with red and gray flaggy sandstones that contain remains of plants, and a few fish scales, which from their character indicate fresh-water conditions. Estimated thickness of Calciferous series, 250 to 300 fathoms. This lower group, as already stated, rests upon the Old Red Sandstone.

# CATALOGUE OF THE CARBONIFEROUS FOSSILS OF CENTRAL AND WESTERN SCOTLAND.

## PLANTÆ.

Plant remains range throughout the several divisions of the Carboniferous strata included in the list, but the greater number are chiefly confined to the roof shales of the several coal seams, on which horizons they are abundant in many localities. *Stigmaria* with its rootlets still attached is common in many of the underclays and sandstones on which the vegetation of the coal seams was rooted. *Lepidodendron*, *Sigillaria*, &c., are also often found as drifted stems in the sandstone, as well as silted up by the sand in the erect position in which they grew. Remains of coniferous plants, showing structure, are sometimes found as drifted specimens in the sandstones and shales, as well as inclosed in nodules of the clay ironstone. *Lepidodendron*, *Sigillaria*, and *Stigmaria*, showing structure in a calcified condition, occur both as erect and prostrate stems in the intercalated beds that lie between some of the sheets of contemporaneous trap of Calciferous Sandstone age on the north-east shore of Arran, and in the Kilpatrick Hills near Bowling. Plant remains occur, although sparingly, in some of the gray flaggy sandstones of the lower Ballagan group; they are also found as drifted specimens in some of the shales with marine organisms that alternate with the limestones. Traces of what are considered fucoidal plants are also found in some of the sandstones and shales that belong to the Marine Limestone group, in both its lower and upper divisions in several localities.

### Alga.

CAUDA-GALLI—marine fucoid.

Corrieburn; Raes Gill.

### Filices.

ADIANTES, *Brongniart.*

*Lindseiformis*, *Bunb.*

Kirktonholm, East Kilbride.

ALETHOPTERIS, *Sternberg.*

*heterophyllia*, *Lindl.*

Baillieston; Shotts.

*lonchitidis*, *Sternb.*

Mount Vernon; Rutherglen.

*serra*, *Lindl.*

Airdrie.

CYCLOPTERIS, *Brongniart.*

*dilatata*, *Lindl.*

Baillieston; Rutherglen.

*orbicularis*, *Brongn.*

Rutherglen; Raes Gill.

NEUROPTERIS, *Brongniart.*

*flexuosa*, *Sternb.*

Greenhill Quarry, Kilmaurs.

*gigantea*, *Sternb.*

Kiltongue coal, Baillieston.

*Grangeri*, *Brongn.*

Greenhill Quarry, Kilmaurs.

*heterophyllia*, *Brongn.*

Baillieston; Carluke.

*Loshii*, *Brongn.*

Baillieston; Rutherglen.

ODONTOPTERIS, *Brongniart.*

*lingulata*, *Schimp.*

Kirktonholm, East Kilbride.

PECOPTERIS, *Brongniart.*

*abbreviata*, *Brongn. MS.*

Woodhill Quarry, Kilmaurs.

*adiantoides*, *Lindl.*

Bathgate.



*Pecopteris*—continued.

*chaerophylloides*, *Brongn.*  
*dentata*, *Lindl.*

*laciniata*, *Lindl.*  
*Loehii*, *Brongn.*  
*muricata*, *Brongn.*  
*nervosa*, *Brongn.*

*SPHENOPTERIS*, *Brongniart.*

*affinis*, *Lindl.*  
*artemisiæfolia*, *Sternb.*  
*bifida*, *Lindl.*  
*Brongniarti*, *Lindl.*  
*crassa*, *Lindl.*  
*crenata*, *Lindl.*  
*dilatata*, *Lindl.*  
*excelsa*, *Lindl.*  
*Hibberti*, *Lindl.*  
*Höninghausi*, *Brongn.*  
*latifolia*, *Brongn.*  
*linearis*, *Sternb.*  
*macilentata*, *Lindl.*  
*obovata*, *Lindl.*  
*polyphylla*, *Lindl.*

Carluke.  
Baillieston; Carluke in first calmy  
limestone series.  
Crossford, in sandy shale.  
Splint and Main coals, Carluke.  
Airdrie.  
Carluke and Airdrie.

Auchengree, Dalry; Raes Gill.  
Airdrie.  
Campsie; Nitshill.  
Baillieston.  
Calder Water.  
Watstone, Stonehouse.  
Baillieston.  
Cot Castle, Stonehouse.  
Banks of Avon near Hamilton.  
Baillieston.  
Baillieston.  
Mouse Water, Jerviswood.  
Cot Castle, Stonehouse.  
Glebe Quarry, East Kilbride.  
Crossford, in sandy shale.

*Equisetaceæ.**ASTEROPHYLLITES*, *Brongniart* (the foliage of *Calamites*).

*chaeræformis*, *Sternb.*  
*dubia*, *Brongn.*  
*foliosus*, *Lindl.*  
*galioides*, *Lindl.*  
*grandis*, *Lindl.*  
*longifolia*, *Brongn.*  
*tuberculata*, *Sternb.*

Slaty band, Shotts.  
Baillieston; Airdrie.  
Baillieston; Shotts.  
Baillieston; Airdrie.  
Rutherglen.  
Rutherglen; Kilmarnock.  
Pyotshaw coal, Baillieston.

*CALAMITES*, *Suckow.*

*approximatus*, *Brongn.*  
*cannæformis*, *Schloth.*  
*inæqualis*, *Lindl.*  
*nodosus*, *Schloth.*  
*pachyderma*, *Brongn.*  
*Suckovii*, *Brongn.*  
*undulatus*, *Brongn.*

Stevenston Quarry; Shotts.  
Rutherglen; Baillieston.  
Carluke, Kiltongue coal.  
Baillieston; Shotts.  
Drumgray coal, Carluke.  
Auldhouse Burn; Garpel Water.  
Drumgray coal, Carluke.

*PINNULARIA*, *Lindley.*

*capillacea*, *Lindl.* (Roots of *Calamites*).

Rutherglen; Shotts.

*SPHENOPHYLLUM*, *Brongniart.*

*erosum*, *Lindl.*  
*Schlotheimii*, *Brongn.*

Baillieston; Rutherglen.  
Pyotshaw coal, Baillieston.

*VOLEMANNA*, *Sternberg.*

*Morissii*, *Hooker* (Fruit of

a species of *Calamites*). Raes Gill; Kirktonholm, E. Kilbride.

**Lycopodiaceæ.**

- CORDAITES**, *Unger*.  
*borassifolia*, *Sternb.* Kennox Water, Douglas; Baillieston.
- FAVULARIA**, *Sternberg*.  
*tessellata*, *Brongn.* Shots; Carluke.
- FLEMINGITES**, *Carruthers*.  
*gracilis*, *Carr.* Slatyband, Lanarkshire.
- HALONTA**, *Lindley*.  
*tortuosa*, *Lindl.* Drumgray coal, Carluke.  
*tuberculosa*, *Lindl.* Stevenston Quarry; Laggan Bay, Arran.
- KNORRIA**, *Sternberg*.  
*taxina*, *Lindl.* (Internal cast of Lepidodendroid trunks). Giffnock.
- LEPIDODENDRON**, *Sternberg*.  
*dilatatum*, *Lindl.* Carluke; Shots.  
*elegans*, *Brongn.* Drumgray coal, Carluke.  
*gracile*, *Lindl.* Virtue Well coal, Shots.  
*Harcourtii*, *Lindl.* Drumgray coal, Carluke.  
*obovatum*, *Sternb.* Possil and Govan blackband.  
*selaginoides*, *Sternb.* Possil blackband.  
*Sternbergii*, *Brongn.* Banton; Shots.  
*transversum*, *Brongn.* Banton.
- LEPIDOPHLOIOS**, *Carruthers*.  
*Wünschiana*, *Carr.* Laggan Bay, Arran.
- LEPIDOPHYLLUM**, *Brongniart*.  
*lanceolatum*, *Brongn.* Shots.
- LEPIDOSTROBUS**, *Brongn.*  
*? ambiguus*, *Binney.* Laggan Bay, Arran.  
*comosus*, *Lindl.* Carluke.  
*? dubius*, *Binney.* Airdrie blackband.  
*latus*, *Binney.* Laggan Bay, Arran.  
*levidensis*, *Binney.* Airdrie blackband.  
*ornatus*, *Brongn.* Slatyband, Shots.  
*pinaster*, *Lindl.* Carluke.  
*tenuis*, *Binney.* Airdrie blackband.  
*Russellianus*, *Binney.* Airdrie blackband.  
*variabilis*, *Lindl.* Possil blackband.  
*Wünschianus*, *Binney.* Laggan Bay, Arran.
- LYGINODENDRON**, *Gourlie*.  
*Landsburgii*, *Gourlie.* Stevenston Quarry.  
*sp.* (silicified wood). Laggan Bay, Arran.
- SIGILLARIA**, *Brongniart*.  
*elegans*, *Brongn.* Main coal, Wishaw.  
*nodosa*, *Lindl.* Main coal, Wishaw.  
*oculata*, *Lindl.* Main coal, Carluke; Shots.  
*organum*, *Sternb.* Dalry, ironstone pits.  
*reniformis*, *Brongn.* Kiltongue coal, Carluke.  
*Serlii*, *Brongn.* Kiltongue coal, Carluke.  
*Saulii*, *Brongn.* Kiltongue coal, Baillieston.

**STIGMARIA, Brongniart** (Roots of arborescent *Lycopodiaceæ*).ficoides, *Brongn.*

Common in underclays and sandstones.

stellata, *D' Eichwald.*

Wildshaw, Douglas.

**ULODENDRON, Lindley.**Lindleyanum, *Sternb.*

Slatyband, Shotts.

majus, *Lindl.*

Coal below limestone, Beith; Carluke.

minus, *Lindl.*

Shotts gas-coal.

**Coniferae.****CARDIOPARON, Brongniart.**Lindleyi, *Carr.*

The Cleuch, Falkirk.

tenellum, *Dawson.*

Swinehill, Stonehouse.

**DADOXYLON, Endlicher.**

sp.

(Stevenston, casts of pith in sandstone; Dalry, in trappean ash.)

sp.

(Auchenskeoch, in coal below lower limestone.)

**TRIGONOCARPUM, Brongniart** (Fruits of taxineous conifers).Gloagianum, *J. Young.*

Calderside; Kirktonholm.

oblongum, *Lindl.*

Stevenston Quarry.

olivæforme, *Lindl.*

Airdrie.

ovatum, *Lindl.*

Baillieston.

**PROTOZOA.**

Two groups of the Protozoa are represented, both of which are confined to the Marine Limestone series, viz. Foraminifera and Spongida. The Foraminifera are represented by several genera and species, all of which, with the exception of *Saccamina Carteri*, Brady, which is found in a bed of hard limestone, have been obtained by the washing of the weathered limestone shales. These shales in many localities break up readily into minute fragments or into a soft clay under the influence of the weather when turned out upon the shale heaps during the working of the limestone. If the shale in this decomposed condition be washed clean it can then easily be searched for the minuter organisms it contains, such as Foraminifera, Ostracoda, Polyzoa, and the smaller spiral shells, these being often found in a state of as good preservation as the organisms from many of our recent deposits. The Foraminifera range from the Lower to the Upper Limestone series, the greatest number of genera and species being found in the lower division.

The discovery of sponge spicules during the last few weeks by one of the active working members of the Geological Society of Glasgow, Mr. John Smith, Eglinton Ironworks, Kilwinning, in a deposit of rotted limestone filling up fissures in the Lower Limestone strata at Cunningham Bedland, Dalry, Ayrshire, proves the abundant existence of sponges, with large siliceous spicula over this portion of the Carboniferous sea bottom during the deposition of this bed of limestone. The spicules, which are comparatively

abundant in the deposit, are of various forms, quadrate and triradial being the most common, others are stellate, while a few are found having a fluke-like or anchor shape. These spicules vary in size from less than a line to fully three-eighths of an inch in diameter, the rays tapering gradually to points, or terminating suddenly, in some of the rays, in rounded knobs.

In this same deposit in which the spicules are found, as well as at other localities within the Dalry district, there occur numerous examples of the organism termed *Serpula parallela*, M'Coy. It is found in the form of bundles of siliceous and minutely tubular rods, these rods being always siliceous, even in strata where all the other organisms are calcareous. It has therefore been conjectured that these bundles of siliceous rods are allied to some of the recent glass sponges, and the discovery of their abundant occurrence in the same deposit along with undoubted sponge spicules, many of which, from their form, are evidently closely related to, if not identical with, *Acanthospongia*, M'Coy, seems to suggest that the spicules and the tubular rods may have been united in the same individual, as is seen to be the case in the recent glass sponge *Hyalonema*. Further researches in this same deposit will probably show whether this view be correct or not. It may be stated in conclusion, that both the spicules and the tubular rods are found in the deposit in a wonderful state of preservation, and of a fine white colour. Some of the rods on being broken show the quartz to have a compact texture like that of chalcedony.

## Foraminifera.

ARCHÆDISCUS, <i>Brady</i> .	
<i>Karteri</i> , <i>Brady</i> .	Brockley; Craigenglen.
CLIMACAMMINA, <i>Brady</i> .	
<i>antiqua</i> , <i>Brady</i> .	Brockley.
ENDOTHYRA, <i>Phillips</i> .	
<i>ammonoides</i> , <i>Brady</i> .	Gillfoot; Gare.
<i>Bowmanni</i> , <i>Phill.</i>	Calderside.
<i>crassa</i> , <i>Brady</i> .	Brockley.
<i>globolus</i> , <i>D'Eichw.</i>	Gillfoot.
<i>macella</i> , <i>Brady</i> .	Orchard; Brockley.
<i>ornata</i> , <i>Brady</i> , and var. <i>tenuis</i> ,	
<i>Brady</i> .	Brockley.
<i>radiata</i> , <i>Brady</i> .	Robroyston; Gillfoot; Brockley.
<i>subtilissima</i> , <i>Brady</i> .	Brockley.
SACCAMMINA, <i>Sars</i> .	
<i>Carteri</i> , <i>Brady</i> .	Main limestone, Braidwood.
STACHEIA, <i>Brady</i> .	
<i>acervalis</i> , <i>Brady</i> .	Hairmyres.
<i>fusiformis</i> , <i>Brady</i> .	Hairmyres.
<i>polytremoides</i> , <i>Brady</i> .	Hairmyres; Craigenglen.
<i>pupoides</i> , <i>Brady</i> .	Capelrig.
TEXTULARIA, <i>DeFrance</i> .	
<i>eximiae</i> , <i>D'Eichw.</i>	Main limestone, Carluke; Brockley.
<i>gibbosa</i> , <i>D'Orb.</i>	Braidwood.
TROCHAMMINA, <i>Parker and Jones</i> .	
<i>anceps</i> , <i>Brady</i> .	Capelrig.
<i>annularis</i> , <i>Brady</i> .	Capelrig.

*Trochammina*—continued.*centrifuga*, Brady.*incerta*, D'Orb.*pusilla*, Geinitz.*Robertsoni*, Brady.

Robroyston.

Robroyston; Boghead.

Gare.

Gare.

*VALVULINA*, D'Orbigny.*bulloides*, Brady.*decurrens*, Brady.*palseotrochus*, Ehrenb.*var. compressa*, Ehrenb.*plicata*, Brady.*Youngi*, Brady.*var. contraria*, Brady.

Brockley.

Brockley.

Robroyston; Brockley.

Brockley.

Calderside.

Brockley; Millburn, Campsie.

Brockley.

**Spongidae.***HYALONEMA*, J. E. Gray.*parallelum*, M'Coy (*Serpula**parallela*, M'Coy).

Cunningham Bedland.

*ACANTHOSPONGIA*, M'Coy.*Smithii*, Young and Young.

Cunningham Bedland.

**HYDROZOA.**

The fossils that have been referred to this class are the *Palæocoryne* of Duncan and Jenkins. So far as yet discovered they seem to be confined to the fenestrated forms of the Polyzoa, such as the various species of *Fenestella*, *Polypora*, *Actinostoma*, and *Synocladia*, the *Palæocoryne* ranging throughout the strata in which the above genera are found. They are, however, believed not to be independent organisms, but processes developed from various portions of the fronds of these fenestrated Polyzoa, the structure of which is identical with *Palæocoryne*.<sup>1</sup>

*PALÆOCORYNE*, Duncan and Jenkins.*radiatum*, Dunc. & Jenk.*Scoticum*, Dunc. & Jenk.

Roughwood; Gilfoot.

Hairmyres.

**ACTINOZOA.**

The greatest number of genera and species of Carboniferous corals have been obtained from the Lower Limestone series, in which they are abundant in several localities. There are, however, certain forms that range into the Upper Limestone strata, while other species are peculiar to this latter division. The best specimens of the compound group of corals are chiefly found in the limestone, while the best preserved examples of the single turbinated forms are those found in the limestone shales, these having their internal structure less crystallized than those from the harder limestones. Many of the specimens, however, both in the limestones and shales are much crushed, being the result of pressure to which they have been subjected since the period when they were embedded.

<sup>1</sup> Quart. Journ. Geol. Soc. xxx. p. 684.

<b>ALVEOLITES</b> , <i>Lamarck.</i> depressa, <i>Flem.</i> septosa, <i>Flem.</i>	Brockley; Boghead, Lesmahagow. Auchenskeoch; Shiells; Gare.
<b>AMPLEXUS</b> , <i>Sowerby.</i> coralloides, <i>Sow.</i> Henslowi, <i>M. Edw.</i> spinosus, <i>De Koninck.</i>	Brockley; Roughwood. Roughwood; Brockley. Brockley; Roughwood.
<b>ASPIDOPHYLLUM</b> , <i>Jas. Thomson.</i> cruciforme, <i>Thoms.</i> elegans, <i>Thoms.</i> Hennedyanum, <i>Thoms.</i> Huxleyanum, <i>Thoms.</i> Koninckianum, <i>Thoms.</i>	Thirdpart, Beith. Thirdpart, Beith. Thirdpart, Beith. Thirdpart, Beith. Thirdpart, Beith.
<b>AULOPHYLLUM</b> , <i>Milne Edwards.</i> Edwardsi, <i>M. Edw.</i> fungites, <i>M. Edw.</i>	Bathgate. Bathgate.
<b>CAMPOPHYLLUM</b> , <i>Edwards and Haime.</i> Murchisoni, <i>M. Edw.</i>	Brockley; Broadstone.
<b>CLADOCHONUS</b> , <i>M'Coy.</i> Bechei, <i>M. Edw.</i> Michelini, <i>M. Edw.</i>	Brockley. Auchenskeoch.
<b>CLISIOPHYLLUM</b> , <i>Dana.</i> bipartitum, <i>M'Coy.</i> coniseptum, <i>M. Edw.</i> Keyserlingi, <i>M'Coy.</i> turbinatum, <i>M'Coy.</i>	Brockley; Roughwood. Langside, Beith. Brockley. Shiells.
<b>COLUMNARIA</b> , <i>Goldfuss.</i> Egertoni, <i>M. Edw.</i>	Broadstone.
<b>CYATHAXONIA</b> , <i>Michelin.</i> cornu, <i>Mich.</i>	Brockley.
<b>CYATHOPHYLLUM</b> , <i>Goldfuss.</i> Archiaci, <i>M. Edw.</i> expansum, <i>M'Coy</i> , sp. giganteum, <i>Mich.</i> Murchisoni, <i>M. Edw.</i> paracida, <i>M'Coy.</i> pseudo-vermiculare, <i>M'Coy.</i> regium, <i>Phill.</i> Stutchburyi, <i>M. Edw.</i>	Broadstone. Broadstone. Auchenskeoch. Bathgate. Brockley. Brockley. Bathgate. Shiells.
<b>CYCLOPHYLLUM</b> , <i>Duncan and Thomson.</i> Bowerbankii, <i>D. &amp; T.</i> fungites, <i>D. &amp; T.</i>	Brockley; Roughwood. Brockley; Roughwood.
<b>DIBUNOPHYLLUM</b> , <i>Thomson &amp; Nicholson.</i> M'Chesneyi, <i>Thoms. &amp; Nich.</i> Muirheadi, <i>Thoms. &amp; Nich.</i> splendens, <i>Thoms. &amp; Nich.</i>	Brockley. Gateside. Gateside.
<b>DIPHYPHYLLUM</b> , <i>Lonsdale.</i> concinnum, <i>Lonsd.</i>	Bathgate.
<b>FISTULIPORA</b> , <i>M'Coy.</i> minor, <i>M'Coy.</i>	Brockley.

- FAVOSITES**, *Lamarck*.  
*parasitica*, *Phill.* Howood; Brockley.
- HETEROPHYLLIA**, *M'Coy*.  
*angulata*, *Dunc.* Auchenskeoch; Brockley.  
*granulata*, *Dunc.* Brockley.  
*M'Coyi*, *Dunc.* Brockley.  
*mirabilis*, *Dunc.* Craigenglen; Brockley.  
*Sedgwicki*, *Dunc.* Brockley.
- KONINKOPHYLLUM**, *Thomson & Nicholson*.  
*interruptum*, *Thoms. & Nich.* Brockley.  
*Lindströmi*, *Thoms. & Nich.* Brockley.  
*magnificum*, *Thoms. & Nich.* Brockley.  
*proliferum*, *Thoms. & Nich.* Bathgate.  
*retiforme*, *Thoms. & Nich.* Brockley.
- LITHODENDRON**, *Phillips*.  
*affine*, *Flem.* Bathgate.  
*fasciculatum*, *Flem.* Corrieburn.  
*irregulare*, *Phill.* Auchenskeoch.  
*juncum*, *Flem.* Brockley; Beith limestone.
- LITHOSTROTION**, *Lhwyd*.  
*aranea*, *M'Coy*, sp. Bathgate.  
*basaltiforme*, *Flem.* Bathgate.  
*decipiens*, *M'Coy*. Boghead, Lesmahagow.  
*ensifer*, *M. Edw.* Bathgate.  
*Portlocki*, *M. Edw.* Corrieburn.
- LONSDALEIA**, *M'Coy*.  
*duplicata*, *Mart.* Muirkirk.  
*floriformis*, *Mart.* Bathgate.  
*rugosa*, *M'Coy*. Boghead, Lesmahagow.
- LOPHOPHYLLUM**, *Edwards and Haime*.  
*eruca*, *M'Coy*. Beith Quarries.  
*reticulatum*, *Thoms. & Nich.* Shiells.  
*Scoticum*, *Thoms. & Nich.* Shiells.
- MICHELINIA**, *De Koninck*.  
*favosa*, *Goldf.* Cleekhimin.  
*tenuisepta*, *Phill.* Broadstone; Roughwood.
- PALEACIS**, *J. Haime*.  
*cyclostoma*, *Phill.* Gare; Auchenskeoch.  
*compressa*, *Meek and Worthen*,  
*var. irregularis*, *R. E., jr.* Gare (Geol. Survey).
- RHODOPHYLLUM**, *Thomson*.  
*Craigianum*, *Thoms.* Trearne, Beith.  
*Phillipsianum*, *Thoms.* Trearne.  
*simplex*, *Thoms.* Brockley.  
*Slimonianum*, *Thoms.* Brockley.
- STENOPORA**, *Lonsdale*.  
*tumida*, *Phill.* Gare; Corrieburn; High Blantyre.
- SYRINGOPORA**, *Goldfuss*.  
*ramulosa*, *Goldf.* Howood; Broadstone.  
*reticulata*, *Goldf.* Boghead, Lesmahagow.

**ZAPHRENTIS, Rafinesque et Clifford.**Bowerbankii, *M. Edw.*cornucopiae, *Mich.*cylindrica, *Scouler, sp.*Enniakilleni, *M. Edw.*Griffithi, *M. Edw.*Guerangeri, *Edw. et Haime.*Michelini, *M. Edw.*nodulosa, *Phill.*patula, *Mich.*Phillipsi, *M. Edw.*spinulosa, *M. Edw.*

Broadstone; Roughwood.

Roughwood.

Brockley; Auchenskeoch.

Auchenskeoch.

Brockley.

Beith Quarries.

Netherfield, Strathavon.

Brockley.

Craigenglen; Roughwood.

Gare; Auchenskeoch.

Brockley.

**ECHINODERMATA.**

The Crinoids are by far the most abundant group of this class, certain genera and species ranging from the Lower to the Upper Limestone series. In the lower division, in the district around Beith and Dalry in Ayrshire, their remains almost exclusively build up a bed of encrinal limestone of considerable thickness. They also occur along with other organic remains in greater or lesser numbers in nearly all the marine limestones where these strata prevail. It is in the limestone shales, however, that the finest specimens of heads and columns have been obtained. The latter show the articulation of the various ossicula, and the organic incrustations often found on the stem, in a much finer state of preservation than those from the hard limestone.

The only other members of this class that have been correctly identified are two forms of sea-urchins, *Archæocidaris* and *Melonites*. Of the former there are at least three or four species, some of which range from the Lower to the Upper Limestone series. The latter genus is the more rare, and appears to be confined to the Lower Limestone group. In the washing of the limestone shales from one or two localities small, microscopic, perforated, wheel-like organisms have been found, that are provisionally referred by Mr. R. Etheridge, jun., to the *Holothuridæ*.

**Echinoidea and Crinoidea.****ARCHÆOCIDARIS, M'Coy.**Münsteriana, *De Koninck.*Scotica, *J. Young.*Urei, *Flem.*

Waterland; Trearne.

Craigenglen.

Craigenglen; Hairmyres.

**MELONITES, David Dale Owen.**Youngii, *Keeping.*

Tearne.

**PALÆCHINUS, Scouler.**sphericus, *M'Coy.*

East Burn, N.E. of Stewarton.

**ACTINOCRINUS, Miller.**globosus, *Miller.*

First calmy limestone, Carluke.

**HYDREIONOCRINUS, De Koninck.**Scoticus, *De Koninck.*

Boghead, Hamilton; High Blantyre.

**PISOCRINUS, De Koninck.**globularis, *De Koninck.*

Boghead, Hamilton; Craigenglen.



PLATYCRINUS, <i>Miller</i> .	
<i>lævis</i> , <i>Miller</i> .	Corrieburn; Beith Quarries.
<i>trigintidactylus</i> , <i>Austin</i> .	Orchard; Boghead, Hamilton.
POTERIOCRINUS, <i>Miller</i> .	
<i>calyx</i> , <i>M'Coy</i> .	Auchenskeoch.
<i>conicus</i> .	Roughwood.
<i>crassus</i> , <i>Miller</i> .	Gare; Orchard.
<i>Maccoyanus</i> , <i>De Koninck</i> .	Howood.
<i>quinquangularis</i> , <i>Miller</i> .	Broadstone.
<i>spissus</i> , <i>De Koninck</i> .	Capelrig.
<i>tenuis</i> , <i>Miller</i> .	Gare; Boghead, Hamilton.
RHODOCRINUS, <i>Miller</i> .	
<i>uniarticulatus</i> , <i>De Kon</i> .	Beith Quarries.

## ANNELIDA.

This class is represented by several genera and species, all of which, with the exception of *Microconchus* or *Spirorbis carbonarius* and *S. helicteres*, are confined to the marine limestone strata of the lower and upper groups. *Microconchus*, so far as yet discovered, seems to be peculiar to the brackish estuarine or fresh-water limestones of the Lower Limestone series, as well as to the fresh-water strata of the Middle Coal and Ironstone group, and that of the Upper Coal formation. It is often found in these beds adherent to stems and leaves of plants, as well as to shells of the genera *Anthracosia*, *Anthracomya*, and *Anthracopectera*. None of the species associated with this annelid are characteristic of purely marine conditions, although the strata in which it is found in the Lower Limestone series sometimes alternate with that which is entirely so.

Many of the species of *Spirorbis* and other smaller annelids are found in excellent preservation in a detached state in the weathered limestone shales. *Serpulites* is chiefly confined to the clay shales, *Arenicolites* to the sandstones of the limestone series, where their tubes or burrows are met with in abundance on several horizons, especially at Giffnock flagstone quarry near Pollokshaws, where every layer of the numerous strata of white flaggy sandstone is seen to be completely riddled by their vertical burrows to the depth of from 3 to 4 inches, which are now filled with a dark blackish-gray clay. Casts of tubes of *Arenicolites*, and convoluted tracks on the horizontal layers of sandstone, the latter being somewhat doubtfully referred to the annelids, are not uncommon in the marine limestone series of both the lower and upper division in several other districts within the borders of our coal-field.

ARENICOLA, <i>Lamarck</i> .	
<i>sp.</i>	Giffnock.
ORTONIA, <i>Nicholson</i> .	
<i>carbonaria</i> , <i>J. Young</i> .	Brockley; Hairmyres; Craigenglen.
SERPULITES, <i>MacLeay</i> .	
<i>carbonarius</i> , <i>M'Coy</i> .	Sculliongour.
<i>compressus</i> , <i>Sow</i> .	Trearne.
<i>membranaceus</i> , <i>M'Coy</i> .	High Blantyre; Gare.

**SPIROBIS, *Lamarck.****caperatus, M'Coy.**carbonarius, Murch., sp.**helicteres, Salter.**spinus, De Koninck.***VERMILIA, *Lamarck.****minuta, Brown.*

Brockley, Gare.

Upper Coal Measures, on shells and plants.

Newton, in mussel-band.

Hairmyres; Roughwood.

Gare; Robroyston.

**CRUSTACEA.**

Several groups of the Crustacea are represented, some of which range from the brackish or fresh-water beds in the limestone series up into the higher beds of the Upper Coal Measures, while other groups are confined to the marine beds of the Lower and Upper Limestone divisions. Trilobites range into the Upper Limestone series, where, so far as known, they finally become extinct. *Estheria* seems to be confined to the brackish or fresh-water shales of the Upper Limestone series, and Upper Coal Measures. The Ostracoda belong to two groups, one of which is purely marine, and is to be obtained by washing the weathered limestone shales and examining the rocks containing them. The other group is characteristic of the brackish or fresh-water strata of our Lower and Upper Coal Measures. This latter group of the Ostracoda differs from that of the marine in being always extremely abundant in the strata containing them. When preserved with the valves entire they may be extracted from the matrix of limestone, ironstone, or shale, as the case may be, by pounding the rock, and afterwards washing the crushed material.

The crustaceans of the genera *Anthrapalaemon*, *Pygocephalus*, *Belinurus*, and *Prestwichia* seem to be confined to the brackish or fresh-water strata of the Upper Coal Measures, and the Middle Coal and Ironstone series. These forms are, however, very rare.

**Ostracoda.****BAIRDIA, *M'Coy.****ampla, Reuss.**bradyana, J. & K.**brevis, J. & K.**curta, var. plebeia, J. & K.**grandis, J. & K.**Hisingeri, Münst.**subcylindrica, Münst.**submucronata, J. & K.***BEYRICHLA, *M'Coy.****arcuata, Bean.**bituberculata, M'Coy.**colliculus* (?), *D'Eichwald.**fastigiata, Jones.**multiloba, Jones.**radiata, J. & K.**rigida, J. & K.*

Hairmyres.

Boghead, Hamilton.

Brockley; Craigenglen.

Orchard; Craigenglen.

*P. punctatus* beds, Carluke.

Brockley; Craigenglen.

Orchard; High Blantyre.

Craigenglen; Brockley.

Airdrie blackband; Shotts.

Orchard; Brockley.

Main limestone, Carluke.

Craigenglen.

Boghead, Hamilton; Craigenglen.

Orchard; Robroyston.

Orchard.

BRADYCINETUS, <i>Sars.</i>	
Rankinianus, <i>J. &amp; K.</i>	Gare, Carluke.
CARBONIA, <i>Jones.</i>	
Carlottæ, <i>J. &amp; K.</i>	Boghead, Hamilton; Gillfoot.
CYPRELLA, <i>De Koninck.</i>	
chrysalidea, <i>De Kon.</i>	Bathgate.
annulata, <i>De Kon.</i>	Bathgate.
CYPRIDELLA, <i>De Koninck.</i>	
Edwardsiana, <i>De Kon.</i>	Bathgate.
var. septentrionalis, <i>J. &amp; K.</i>	Trearne.
CYPRIDINA, <i>Milne Edwards.</i>	
Grossartiana, <i>J. &amp; K.</i>	Blackburn, Bathgate.
Hunteriana, <i>J. &amp; K.</i>	Main limestone, Braidwood.
Phillipsiana, <i>J. &amp; K.</i>	Main limestone, Braidwood.
primæva, <i>M'Coy.</i>	Brockley.
radiata, <i>J. &amp; K.</i>	Airdrie blackband.
Youngiana, <i>J. &amp; K.</i>	Gare, Carluke.
scoriacea, <i>J. &amp; K.</i>	Gare, Carluke.
Thomsoniana, <i>J. &amp; K.</i>	Gare, Carluke.
CYPRIDINELLA, <i>Jones and Kirkby.</i>	
intermedia, <i>J. &amp; K.</i>	Bathgate.
superciliosa, <i>J. &amp; K.</i>	Trearne.
CYTHERE, <i>Müller.</i>	
amputata, <i>Kirkby.</i>	Main limestone, Carluke.
bilobata, <i>Münst.</i>	Broadstone; Braidwood.
cornigera, <i>J. &amp; K.</i>	Orchard; Robroyston.
Crosskeyana, <i>J. &amp; K.</i>	Bathgate.
cuneola, <i>J. &amp; K.</i>	Robroyston; Orchard.
(Carbonia) fabulina, <i>J. &amp; K.</i>	Craigenglen; Airdrie blackband.
intermedia, <i>Münst.</i>	Carluke.
Jonesiana, <i>Kirkby.</i>	Craigenglen.
obtusa, <i>J. &amp; K.</i>	Tirfergus Glen, Campbeltown.
(Carbonia) pungens, <i>J. &amp; K.</i>	Craigenglen.
(Carbonia) Rankiniana, <i>J. &amp; K.</i>	Same locality as <i>C. fabulina</i> .
reticulosa, <i>J. &amp; K.</i>	Gare.
(Carbonia) secans, <i>J. &amp; K.</i>	Craigenglen.
(Carbonia) subula, <i>J. &amp; K.</i>	Craigenglen.
ventricornis, <i>J. &amp; K.</i>	Robroyston; Gillfoot.
CYTHERELLA, <i>Jones.</i>	
inflata, <i>Münst.</i>	Craigenglen; Dockra.
simplex, <i>J. &amp; K.</i>	Raes Gill.
ENTOMIS, <i>Jones.</i>	
concentrica, <i>De Kon.</i>	Main limestone, Carluke.
ENTOMOCONCHUS, <i>M'Coy.</i>	
globosus, <i>J. &amp; K.</i>	Broadstone.
KIRKBYA, <i>Jones.</i>	
annectans, <i>J. &amp; K.</i>	Orchard; Craigenglen.
bipartita, <i>J. &amp; K.</i>	Orchard; Craigenglen.
Eichwaldiana, <i>J. &amp; K.</i>	Swindridge.
oblonga, <i>J. &amp; K.</i>	Brockley.
Permiana, <i>Jones.</i>	Orchard; Robroyston; Brockley.

*Kirkbya—continued.*

*plicata*, *J. & K.*  
*Scotica*, *J. & K.*  
*spinosa*, *J. & K.*  
*umbonata*, *D'Eichw.*  
*Urei*, *Jones.*

Tirfergus Glen, Campbeltown.  
 Tirfergus Glen, Campbeltown.  
 Craigenglen; Garpel Water.  
 Brockley, Craigenglen.  
 Robroyston; Brockley; H. Blantyre.

*LEPERDITIA, Rouault.*

*Armstrongiana*, *J. & K.*  
*compressa*, *J. & K.*  
*oblonga*, *J. & K.*  
*Okeni*, *Münst.*, and *vars.*  
*Youngiana*, *J. & K.*

Brockley; Howrat; Craigie.  
 Craigenglen.  
 Main limestone, Carluke.  
 Gare; Orchard; Robroyston.  
 Den, Dalry.

*POLYCOPE, Sars.*

*simplex*, *J. & K.*  
*Youngiana*, *J. & K.*

First calmy limestone, Braidwood.  
 South Hill, Campsie.

*YOUNGIA, Jones and Kirkby.*

*rectidorsalis*, *J. & K.*

Robroyston.

**Macrura.***ANTHRAPALEMON, Salter.*

*Grossarti*, *Salter.*

Airdrie blackband.

**Stomapoda.***PYGOCEPHALUS, Huxley.*

*Cooperi*, *Huxley.*  
*Huxleyi*, *Woodward.*

Woodhill Quarry, Kilmaurs.  
 Inkerman, Paisley.

**Trilobita.***GRIFFITHIDES, Portlock.*

*Eichwaldi*, *Fischer*, *sp.*  
*globiceps*, *Portl.*  
*mesotuberculatus*, *M'Coy.*

Orchard; Howrat.  
 Main limestone, Carluke.  
 Bowertrapping; Gare.

**Phyllopoda.***CYCLUS, De Koninck.*

*Rankini*, *H. Woodward.*

First calmy limestone, Carluke.

*DITHYROCARIS, Scouler.*

*Colei*, *Portl.*  
*glabra*, *Woodw. and Ether.*

Craigenglen.  
 Shale above Calderwood cement  
 stone, E. Kilbride; shale above  
 first calmy limestone, Raes Gill.

*granulata*, *Woodw. and Ether.*  
*ovalis*, *Woodw. and Ether.*  
*tenuistriatus*, *M'Coy.*  
*testudineus*, *Scouler.*

Do.  
 Do.  
 Robroyston; Auchinbeg.  
 E. Kilbride; Raes Gill; Orchard,  
 teeth only.  
 E. Kilbride, with *D. glabra*.

*tricornis*, *Scouler.*

*ESTHERIA, Rüppell.*

*punctatella*, *Jones.*  
*striata*, *Münster.*  
*tenella*, *Jordan.*

Arden; Linn Spout, Dalry.  
 Lower coal series in cannel coal.  
 Palace Craig ironstone, Airdrie.

**Merostomata.**

- BELINURUS** (König), *Baily*.  
     *trilobitoides*, König & Buckl. Woodhill Quarry, Kilmaurs.  
**EURYPTERUS**, *De Kay*.  
     *Scouleri*, *Hibbert*. Kirkton Quarry. Type specimen in  
     Andersonian Museum.  
**PRESTWICHIA**, *H. Woodward*.  
     *rotundata*, *H. Woodward*. Woodhill Quarry, Kilmaurs.

**ANNULOSA.**

This class is represented by two genera of Myriapoda, *Euphoberia* and *Xylobius*, found in nodules of impure clay ironstone in the brackish or fresh water strata of the Upper Coal Measures at Kilmaurs, Ayrshire; also a segment of an Arachnid found in a nodule of ironstone in the Limestone series of the Carlisle district by Dr. Rankin, which Mr. Henry Woodward refers to *Eoscorpius*.

**Myriapoda.**

- EUPHOBERIA**, *Meek and Worthen*.  
     *Brownii*, *H. Woodward*. Woodhill Quarry, Kilmaurs.  
**XYLOBIUS**, *Dawson*.  
     *sigillariæ*, *Dawson*. Woodhill Quarry, Kilmaurs.

**Arachnida.**

- EOSCORPIUS**, *Meek and Worthen*, sp. Gillfoot Shale.

**POLYZOA.**

The Polyzoa of the limestone strata are represented by a numerous group of genera and species, some of which range from the lower to the upper series of beds, and are chiefly confined to the shales that alternate with the limestones. In the limestone itself they are rarely met with, except in one or two localities, such as at Trearne Quarry, near Beith, where they are chiefly confined to a narrow band in the limestone. In some localities they crowd the surface of the various layers of shale, and are found in all states of preservation, from mere fragments of fronds up to specimens that measure from 2 to 5 inches in length. In some of the weathered shales in which the Polyzoa occur numerous fragments may be obtained by washing the shales, being besides well suited for microscopic examination.

- ACTINOSTOMA**, *Dr. Young and J. Young*.  
     *fenestratum*, *Y. & Y.* Hairmyres; High Blantyre.  
**ARCHÆOPORA**, *De Koninck*.  
     *nexilis*, *De Koninck*. High Blantyre; Gillfoot.  
**CABINELLA**, *Etheridge, jun.*  
     *cellulifera*, *Ether.* Gare; Robroyston; Orchard.  
**CERIOPORA**, *Goldfuss*.  
     *interporosa*, *Phill.* Gare; Brockley; High Blantyre.  
     *similis*, *Phill.* Capelrig; Gare; Corrieburn.

- DIASTOPORA**, *Lamouroux*.  
     *megastoma*, *M'Coy*.      Gare; High Blantyre; Hairmyres.
- FENESTELLA**, *Lonsdale*.  
     *bicellulata*, *Ether*.      Boghead, Hamilton.  
     *carinata*, *M'Coy*.      High Blantyre; Hairmyres.  
     *crassa*, ? *M'Coy*.      Beith Quarries.  
     *flabellata*, *Phill*.      Corrieburn; Beith quarries.  
     *formosa*, ? *M'Coy*.      First calmy limestone, Carluke;  
                                     Corrieburn.
- frutex*, *M'Coy*.      Corrieburn; Gillfoot.  
     *hemispherica*, *M'Coy*.      Roughwood.  
     *membranacea*, *Phill*.      Craigenglen; High Blantyre.  
     *Morrisii*, *M'Coy*.      Howrat; Corrieburn.  
     *multiporata*, *M'Coy*.      Roughwood; Corrieburn.  
     *nodulosa*, *Phill*.      Corrieburn; Beith quarries.  
     *plebeia*, *M'Coy*.      High Blantyre; Hairmyres.  
     *quadridentata*, ? *M'Coy*.      Gillfoot; Gare.  
     *tenuifila*, *Phill*.      Gare; High Blantyre.  
     *tuberculo-carinata*, *Ether*.      High Blantyre.  
     *undulata*, *Phill*.      Gillfoot.
- GLAUCONOME**, *Lonsdale*.  
     *aspera*, *Dr. Young and J. Young*.      Hairmyres.  
     *bipinnata*, *Phill*.      Corrieburn.  
     *elegans*, *Y. & Y.*      Hairmyres.  
     *flexicarinata*, *Y. & Y.*      High Blantyre; Gillfoot.  
     *gracilis*, *M'Coy*.      Beith Quarries.  
     *grandis*, ? *M'Coy*.      Beith Quarries.  
     *laxa*, *Y. & Y.*      Hairmyres.  
     *marginalis*, *Y. & Y.*      Hairmyres; Gillfoot.  
     *pulcherrima*, ? *M'Coy*.      Hairmyres.  
     *retroflexa*, *Y. & Y.*      Beith Quarries; Hairmyres.  
     *stellipora*, *Y. & Y.*      Hairmyres; Gare.  
     var. *spinosa*, *Y. & Y.*      Hairmyres; Gare.
- GORGONIA**, *Linné*.  
     *Lonsdaliana* (?), *M'Coy*.      Auchenskeoch.
- HEMITRYPA**, *Phillips*.  
     *Hibernica*, *M'Coy*.      Highfield Quarry.
- HYPHASMOPORA**, *Etheridge*.  
     *Buskii*, *Ether*.      High Blantyre.
- POLYPORA**, *M'Coy*.  
     *dendroides*, *M'Coy*.      Corrieburn; Beith Quarries.  
     *papillata*, ? *M'Coy*.      Auchenskeoch; first calmy lime-  
                                     stone, Carluke.  
     *tuberculata*, *Prout*.      Hairmyres; Beith Quarries.
- PTYLOPORA**, *M'Coy*.  
     *pluma*, *M'Coy*.      Corrieburn.
- RHABDOMESON**, *Dr. Young & J. Young*  
     (*Millepora*, *Phill*).  
     *gracile*, *Phill*.      Hairmyres; Trearne.  
     *rhombiferum*, *Phill*.      Hairmyres; Capelrig.

SULCOBRETEPORA, *D'Orbigny*.parallela, *Phill.*rariocosta, *M'Coy*.Robertsoni, *Y. & Y., MS.*

Gare; Hairmyres; Beith.

Corrieburn; Brockley.

Trearne.

SYNOCLADIA, *King*.carbonaria, *Ether.*

High Blantyre; Gillfoot.

THAMNISCUS, *King*.Rankini, *Y. & Y.*

Gillfoot; Gare.

sp.

High Blantyre.

VINCULARIA, *DeFrance*.approximata, ? *D'Eichwald.*Binniei, *Ether.*dichotoma, *M'Coy.*

Crosshouse; Shiella.

Mouse Water, Wilsontown.

Corrieburn.

## BRACHIOPODA.

This division of the Mollusca is well represented in both the Lower and Upper Marine Limestone series, the greatest number of genera and species being found in the lower group. They also occur in the limestone strata of the Millstone Grit series, one or two forms ranging upwards into the lower strata of the Upper Coal Measures.

The finest preserved specimens, showing the spines and other external markings, are those obtained from the shales that alternate with the limestone. Productæ are very abundant, being the characteristic genus met with in some of the lower limestones. Lingulæ abound on certain horizons in the shales of the limestone and Middle Coal and Ironstone series.

At one or two localities in the neighbourhood of Glasgow the remains of several species of Brachiopods and various other shells, chiefly casts, have been met with in the working of a bed of white sandstone that seems to occupy a position on the borders of the Upper Limestone and Millstone Grit series, this being the only instance we know of in which the remains of marine Mollusca have been met with in any of the sandstone strata of our coal-field.

ATHYRIS, *M'Coy*.ambigua, *Sow.*pisum, *Dar.*plano-sulcata, *Phill.*Royssii, *Lév.*

Gare; Orchard; Beith Quarries.

Brockley.

Craigenglen; Brockley.

Brockley; Beith Quarries.

CAMAROPHORIA, *King*.crumena, *Mart.*globulina, *Phill.*

Main limestone, Campsie.

Brockley; Auchenskeoch.

CHONETES, *Fischer*.Buchiana, *De Koninck.*

Millburn; Gare; Gillfoot; Swindridge.

Laguessiana, *De Koninck.*

Boghead, Hamilton; High Blantyre; Gare.

Craigenglen; Gillfoot.

polita, *M'Coy.*CRANIA, *Retzius*.quadrata, *M'Coy.*

Gare; High Blantyre; Capelrig.

<b>DISCINA</b> , <i>Lamarck</i> . <i>nitida</i> , <i>Phill</i> .	High Blantyre; E. Kilbride quarries; Orchard.
<b>LINGULA</b> , <i>Bruguère</i> . <i>mytiloides</i> , <i>Sow</i> .	Boghead, Hamilton; High Blantyre; Orchard.
<i>Scotica</i> , <i>Dav</i> .	Gare; Limekilnburn; Hall Hill, Leamahagow.
<i>squamiformis</i> , <i>Phill</i> .	Boghead, Hamilton; Craigenglen; Gare.
<i>Thomsoni</i> , <i>Dav</i> .	Tirfergus Glen, Campbeltown.
<b>ORTHIS</b> , <i>Dalman</i> . <i>Michelini</i> , <i>Lév</i> . <i>resupinata</i> , <i>Martin</i> .	Roughwood and other Beith Quarries. Gare; Orchard; Bowertrapping; Limekilnburn.
<b>PRODUCTUS</b> , <i>Sowerby</i> . <i>aculeatus</i> , <i>Martin</i> .	Main limestone, Campsie and Braidwood.
<i>carbonarius</i> , <i>De Koninck</i> .	Specimen in the Jermyn Street Museum, said to be from the Glasgow coal-field.
<i>cora</i> , <i>D'Orb</i> .	Arden; Bowertrapping; Boghead, Hamilton.
<i>costatus</i> , <i>J. de C. Sow</i> . <i>fimbriatus</i> , <i>J. de C. Sow</i> .	Orchard, Beith Quarries. Beith Quarries; main limestone, Campsie.
<i>giganteus</i> , <i>Martin</i> . <i>latissimus</i> , <i>J. de C. Sow</i> . <i>longispinus</i> , <i>Sow</i> . <i>mesolobus</i> , <i>Phill</i> .	Bowertrapping; Beith Quarries. Craigenglen; Bowertrapping. High Blantyre; Gare; Corrieburn. Main limestone, Campsie and Carlisle; Arden.
<i>punctatus</i> , <i>Martin</i> . <i>pustulosus</i> , <i>Phill</i> . <i>scabriculus</i> , <i>Martin</i> . <i>semireticulatus</i> , <i>Martin</i> . <i>var. Martini</i> , <i>Sow</i> . <i>sinuatus</i> , <i>De Koninck</i> . <i>spinulosus</i> , <i>Sow</i> . <i>undatus</i> , <i>DeFr</i> .	Castlecary; Craigenglen; Beith. Braehead; Langside, Beith. Gare; Bowertrapping; Arden. Arden; Gare; High Blantyre. Arden; Gare; High Blantyre. Bowertrapping; Arden. Brockley; Beith Quarries. Castlecary; main limestone, Carlisle and Campsie.
<i>Youngianus</i> , <i>Dav</i> .	Corrieburn; Beith Quarries.
<b>RETZIA</b> , <i>King</i> . <i>radialis</i> , <i>Phill</i> .	Gare; Limekilnburn; Brockley.
<b>RHYNCHONELLA</b> , <i>Fischer</i> . <i>pleurodon</i> , <i>Phill</i> .	Corrieburn; Craigenglen; High Blantyre.
<i>pugnus</i> , <i>Martin</i> .	Arden; Bowertrapping; Gare.
<b>SPIRIFERA</b> , <i>Sowerby</i> . <i>Carlukensis</i> , <i>Dav</i> . <i>duplicicosta</i> , <i>Phill</i> . <i>glabra</i> , <i>Martin</i> .	Gillfoot; Broadstone; Brockley. Beith Quarries; Brockley. Orchard; Beith Quarries.



*Spirifera—continued.*

*lineata, Martin.*  
*ovalis, Phill.*  
*pinguis, Sow.*  
*trigonalis, Mart.*  
     *var. bisulcata, Sow.*  
*triradialis, Phill.*  
*Ursi, Flem.*

Arden; Orchard; Beith Quarries.  
 Brockley; Broadstone; Corrieburn.  
 Trearne; Puduff Burn, Beith.  
 Arden; Bowertrapping; H. Blantyre.  
 Arden; Craigenglen; H. Blantyre.  
 Dockra.  
 South Hill, Campsie; Brockley;  
 Orchard; Bowertrapping.

*SPIRIFERINA, D'Orbigny.*

*cristata, var. octoplicata, Sow.*  
*insculpta, Phill.*  
*laminosa, M'Coy.*

Capelrig; Gare; Beith Quarries.  
 Gare; Gillfoot.  
 Auchenskeoch; Brockley.

*STREPTORHYNCHUS, King.*

*crenistris, Phill.*  
*var. radialis, Phill.*  
*var. robusta, Hall.*

Gare; Orchard; Beith Quarries.  
 Orchard; Roughwood.  
 Tirfergus Glen, Campbeltown; Hal-  
 lerhirst.

*var. senilis, Phill.*

Bowertrapping.

*STROPHOMENA, Rafinesque.*

*rhomboidalis, Wahl. var.*  
*analoga, Phill.*

Bowertrapping; Howood; main  
 limestone, Campsie.

*var. distorta, J. de C. Sow.*

Gare; Bowertrapping.

*TEREBRATULA, Lkwyd.*

*hastata, Sow.*

Gare; Arden; Bowertrapping; Beith  
 Quarries.

*var. Gillingensis, Dav.*

Craigenglen; Corrieburn.

*var. sacculus, Martin.*

Brockley; Beith Quarries.

*var. vesicularis, De Kon.*

Bowertrapping; Arden.

## LAMELLIBRANCHIATA.

This class of the Mollusca is represented by a considerable number of genera and species belonging to both the Monomyaria and Dimyaria groups. They range throughout the several divisions of our Carboniferous strata, the marine species being met with in greatest numbers in the shales and clay ironstones that alternate with the limestones, comparatively few species being found in the purer limestones themselves.

The fresh or brackish water group of the Mollusca represented by the genera *Anthracosia*, *Anthracomya*, and *Anthracoptera*, are confined chiefly to the mussel-band ironstones and shales of the Upper Coal Measures, one or two species being found in similar strata in the Middle Coal and Ironstone series. None of this latter group of the Mollusca are to be met with in any of the beds yielding the characteristic marine organisms of the system, while, on the other hand, none of the marine forms are found in the strata yielding the above-mentioned genera of Mollusca. In the one or two instances where a specimen of *Anthracosia* has been said to have been found associated with marine organisms, it is probable that it may have been derived from some

earlier deposit, or drifted to the sea from its own proper habitat. It is evident from all the circumstances under which they are found, that this fresh, or brackish water group of the Mollusca has, in our Scottish coal-field, lived under quite different conditions from the marine forms found in the limestone series.

#### Monomyaria.

ANOMIA, <i>Linné.</i>	
<i>antiqua, M'Coy.</i>	Linn limestone (Geol. Surv.).
AVICULA, <i>Klein.</i>	
<i>angusta, M'Coy.</i>	Gare.
<i>concinna, M'Coy.</i>	Linn limestone shale.
<i>cycloptera, Phill.</i>	"Near Glasgow" ( <i>H. &amp; E. Cat.</i> ).
<i>decussata, M'Coy.</i>	Linn limestone shale.
<i>levigata, M'Coy.</i>	Howrat.
<i>prisca, M'Coy.</i>	Lingula ironstone, Carluke.
AVICULOPecten, <i>M'Coy.</i>	
<i>arenosus, Phill.</i>	High Blantyre; main limestone, Campsie.
<i>ocelatus, M'Coy.</i>	Boghead, Hamilton.
<i>clathratus, M'Coy.</i>	Boghead, Hamilton.
<i>cognatus, M'Coy.</i>	Main limestone, Braidwood.
<i>concavus, M'Coy.</i>	Boghead, Lesmahagow.
<i>concentricostriatus, M'Coy.</i>	Corrieburn.
<i>consimilis, M'Coy.</i>	Bowertrapping; Craigenglen.
<i>dissimilis, Flem.</i>	Main limestone, Carluke.
<i>docens, M'Coy.</i>	E. Kilbride.
<i>Dumontianus, De Kon.</i>	Main limestone, Braidwood.
<i>duplicicosta, M'Coy.</i>	Lingula ironstone, Carluke.
<i>ellipticus, Phill.</i>	Teiglam Burn.
<i>elongatus, M'Coy.</i>	Roughwood.
<i>fallax, M'Coy.</i>	Lingula ironstone, Carluke.
<i>fimbriatus, Phill.</i>	Craigenglen; Corrieburn.
<i>fiabellulus, M'Coy.</i>	Carluke ( <i>H. and E. Cat.</i> ).
<i>flexuosus, M'Coy.</i>	Hillhead, Beith.
<i>granosus, Phill.</i>	Corrieburn.
<i>incrassatus, M'Coy.</i>	Auchenskeoch.
<i>interstitialis, Phill.</i>	Gare; Bowertrapping; Craigenglen.
<i>Jonesii, M'Coy.</i>	Corrieburn; Gare.
<i>Knockonniensis, M'Coy.</i>	Boghead, Hamilton; Brockley.
<i>macrotis, M'Coy.</i>	Teiglam Burn.
<i>micropterus, M'Coy.</i>	First calmy limestone, Carluke.
<i>orbiculatus, M'Coy.</i>	Waygateshaw.
<i>ornatus, Ether.</i>	Calderwood cement shales.
<i>oryza, Ether.</i>	Second Kingshaw limestone, Carluke.
<i>ovatus, M'Coy.</i>	Linn limestone, Dalry.
<i>papyraceus, Goldf.</i>	Glebe Quarry, E. Kilbride; Inker-man.
<i>plano-radiatus, M'Coy.</i>	Boghead, Lesmahagow.
<i>plicatus, Sow.</i>	Main limestone, Carluke; Craigenglen.

**Aviculopecten—continued.**

radiatus, *Phill.*  
 scalaris, *Sow.*  
 sclerotis, *M'Coy.*  
 semicircularis, *M'Coy.*  
 semistriatus, *M'Coy.*  
 serratus, *M'Coy.*  
 simplex, *De Koninck.*

stellaris, *Phill.*

? subelongatus, *M'Coy.*  
 tessellatus, *Phill.*  
 variabilis, *M'Coy.*

**PECTEN, Linné.**

Sowerbii, *M'Coy.*

**PINNA, Linné.**

flabelliformis, *Mart.*

flexicosta, *M'Coy.*  
 Ivaniskiana, *M. V. et K.*  
 spatula, *M'Coy.*

**POSIDONOMY, Bronn.**

corrugata, *Ether.*

vetusta, *Sow.*

**PTERONITES, M'Coy.**

angustatus, *M'Coy.*  
 fluctuosus, *Ether.*  
 latus, *M'Coy.*  
 persulcatus, *M'Coy.*  
 regularis, *Ether.*  
 semisulcatus, *M'Coy.*

**ANTHRACOMYA, Salter.**

modiolaris, *Sow.*

**ANTHRACOPTERA, Salter.**

carinata, *Sow.*  
 modiolaris, *Sow.*  
 quadrata, *Sow.*

**ANTHRACOSIA, King.**

acuta, *Sow.*

aquilina, *Sow.*  
 centralis, *Sow.*  
 Dawsoni, *Brown.*  
 ovalis, *Mart.*

Craigenglen.

Gare.

Boghead, Hamilton; Craigenglen.

Roughwood.

East Burn, Stewarton.

Newfield.

Gare; Orchard; Cunningham Bedland.

Corrieburn; main limestone, Braidwood.

Calderside, Craigenglen.

Gare; Lingula ironstone, Carluke.

High Blantyre; Boghead, Hamilton.

Beith quarries; Brockley; Bishopbriggs.

Howcommon, Craigie.

Lingula ironstone, Carluke.

Inkerman, Paisley; Dykehead; Craigenglen.

Boghead, Hamilton; Linn limestone, Dalry.

Burn Anne, opposite Cessnock Castle.

Lesmahagow (*H. and E. Cat.*).

Craigenglen.

Corrieburn; Cunningham Bedland.

Craigenglen; Corrieburn.

Linn Spout, Dalry.

Carluke (*H. and E. Cat.*).

**Dimyaria.**

Roof shales of splint coal, Shettleston and Carluke.

Bargeddie pits, Shettleston.

Bargeddie pits, Shettleston.

Shales of the splint coal, Shotts.

Shales of the splint and upper coals, Carluke and Shotts.

Shales of the Kiltongue coal, Shotts.

Airdrie blackband.

Possil ironstone.

Airdrie blackband; Bellside ironstone, Carluke.

**Anthracosia**—*continued.**phaseola, Sow.**robusta, Sow.**subconstricta, Sow.**Urei, Flem.*

Airdrie blackband; Shotts.

Upper coal shales, Shotts and Carluke.

Shales of the splint coal, Carluke.

Shales of the upper coals, Rutherglen and Shettleston.

**ARCA, Linné.***arguta, De Kon.**faba, De Kon.**fimbriata, De Kon.**Lacordaireana, De Kon.**reticulata, M'Coy.*

Gare; Lingula ironstone, Carluke.

Gare.

Auchinbeg.

Orchard; Gare.

Craigenglen.

**AXINUS, Sowerby.***axiniformis, Phill.**carbonarius, Portl.**deltoides, Phill.*

Gare; Newfield; Castlecary.

Orchard; Beith Quarries.

Gare; Boghead, Hamilton; Craigenglen.

Shale of blackband, Govan and Paisley.

Lugton Water, near Lugton Inn.

*orbicularis, M'Coy.**sulcatus, Sow.***CARDIOMORPHA, De Koninck.***elliptica, De Kon.**lamellosa, De Kon.**oblonga, Sow.**orbicularis, M'Coy.**Puzosiana, De Kon.**tenera, De Kon.**radiata, De Kon.*

Gare.

Bourock, north of Dunlop.

Gare; Robroyston; Craigenglen.

High Blantyre.

Gare; Robroyston.

Lingula ironstone, Carluke.

Robroyston, in Lingula shale.

**CONOCARDIUM, Bronn.***aliforme, Sow.**armatum, Phill.**decussatum, Ether.*

Capelrig; Roughwood; Corrieburn.

Main limestone, Carluke.

Williamwood.

**CYPRICARDIA, Lamarck.***acuticarinata, Armstrong.**crebricostata, Armstrong.**cylindrica, M'Coy.*

Gare; Orchard; Hairmyres.

Gare; Robroyston.

Corrieburn; first calmy limestone, Carluke.

Craigenglen.

Lingula ironstone, Carluke.

Orchard; Hairmyres; Craigenglen.

Craigenglen; main limestone, Braidwood.

*glabrata, Phill.**oblonga, M'Coy.**rhombea, Phill.**striato-lamellosa, De Kon.**tumida, M'Coy.***EDMONDIA, De Koninck.***compressa, M'Coy.**Egertoni, M'Coy.**gibbosa, M'Coy.**oblonga, M'Coy.**prisca, M'Coy.**quadrata, M'Coy.*

Gare.

Fiddler's Burn.

High Blantyre; Craigenglen.

Gare; Robroyston.

Langside, Beith.

Lingula ironstone, Carluke.

Sculliongour; Gillfoot.

- Edmondia**—*continued*.  
*rudis*, *M'Coy*.  
*scalaris*, *M'Coy*.  
*unioniformis*, *Phill.*
- LEDA**, *Schumacher*.  
*attenuata*, *Flem.*  
*birostrata*, *M'Coy*.  
*clavata*, *M'Coy*.  
*intermedia*, *Ether.*  
*longirostris*, *M'Coy*.  
*oblonga*, *M'Coy*.
- LEPTODOMUS**, *M'Coy*.  
*costellatus*, *M'Coy*.  
*fragilis*, *M'Coy*.
- LITHODOMUS**, *Cuvier*.  
*Jenkinsoni*, *M'Coy*.
- MACTRA**, *Linné*.  
*? incrassata*, *M'Coy*.
- MODIOLA**, *Lamarck*.  
*divisa*, *M'Coy*.  
*lingualis*, *Phill.*  
*lithodomoides*, *Ether.*  
*Macadami*, *Portl.*  
*megaloba*, *M'Coy*.  
*subparallela*, *Portl.*
- MYACITES**, *Bronn*.  
*sulcata*, *Flem.*
- MYALINA**, *De Koninck*.  
*crassa*, *Flem.*  
*lamellosa*, *De Kon.*  
*triangularis*, *Sow.*  
*Verneuillii*, *M'Coy*.
- MYTILUS**, *Linné*.  
*comptus*, *M'Coy*.
- NUCULA**, *Lamarck*.  
*acuta*, *Sow.*  
*brevirostris*, *Phill.*  
*gibbosa*, *Flem.*  
*lævirostrum*, *Portl.*  
*leiorhyncha*, *M'Coy*.  
*lineata*, *Phill.*  
*luciniformis*, *Phill.*  
*palmae*, *Sow.*  
*unilateralis*, *M'Coy*.
- High Blantyre; Beith Quarries.  
 Langside, Beith.  
 High Blantyre; Craigenglen.  
 Orchard; Swindridge; Craigenglen.  
 Auchinbeg.  
 Orchard; Auchinbeg; Robroyston.  
 Orchard; Robroyston.  
 South Hill, Campsie; Thornton;  
 Orchard.  
 Orchard; Gare.  
 Boghead, Hamilton; Campsie main  
 limestone.  
 Lingula ironstone, Carluke.  
 Lingula ironstone, Carluke; Lime-  
 kilns.  
 Craigenglen.  
 Craigenglen; shale, Linn limestone.  
 Craigenglen; Lingula ironstone, Car-  
 luke.  
 Beith Quarries.  
 Craigenglen; Lingula ironstone,  
 Carluke.  
 Craigenglen.  
 Calderside.  
 Craigenglen; Beith Quarries; High  
 Blantyre.  
 Corrieburn; Roughwood.  
 Polbath Burn, 2 m. N. of Galston.  
 Polbath Burn, 2 m. N. of Galston.  
 Auchinbeg; Craigenglen; Inkerman.  
 Auchinbeg.  
 Orchard; Gare.  
 Calder Water.  
 Gare; Orchard; Craigenglen; Swind-  
 ridge.  
 Gare; Orchard.  
 Fiddler's Burn, opposite Headamuir.  
 Robroyston; Gare; Orchard; Craig-  
 englen.  
 Craigenglen; Orchard; Gare.  
 Raes Gill.  
 High Blantyre.

**SANGUINOLITES, M'Coy.**  
*curtus, M'Coy.**discors, M'Coy.*  
*iridinoides, M'Coy.*  
*plicatus, Portl.*  
*radiatus, Portl.*  
*subcarinatus, M'Coy.*  
*transversus, Portl.*  
*tricostatus, Portl.*  
*variabilis, M'Coy.*

Fiddler's Burn, near Nellfield Farm-house.

Craigenglen; Bowertrapping.  
Orchard; Limekilnburn; Auchinbeg.  
Gare; Inkerman; Beith Quarries.  
Shale above Calderwood cement.  
Beith Quarries.  
Inkerman, Paisley.  
High Blantyre; Beith Quarries.  
High Blantyre; main limestone,  
Carluke.**SOLENOMYA, Phillips.**  
*primæva, Phill.***SOLENOPSIS, M'Coy.**  
*minor, M'Coy.***VENUS, Linnæus.**  
*elliptica, Phill.*  
*sp.*

Hairmyres; Roughwood.

Robroyston; Auchinbeg.

Craigenglen; Gare.  
Orchard.**Gasteropoda.**

The univalve spiral shells belonging to the Gasteropoda that have been found are wholly confined to the Marine Limestone and Millstone Grit series, none being found in the strata of the Middle Coal and Ironstone, nor in the Upper Coal Measures. This class is represented by some fifteen genera and a considerable number of species, several of which are rare. They are more abundant in the shales that alternate with the limestone than in the limestone itself, the best preserved specimens being those found in the shales. The smaller forms are easily obtained by washing and searching the weathered shales known to contain them.

The highest division of the Gasteropoda—the Nucleobranchiata—are represented by *Bellerophon* and *Porcellia*. Of the former there are eight or nine species, the greater number of which are chiefly confined to the limestone shales. *Porcellia* is represented by only one species, which is very rare in most localities, and is also apparently confined to the shales.

**CHITON, Linné.***gemmatus, De Kon.*  
*humilis, Kirkby.*  
*Burrowianus* (?), *Kirkby.*Gallowhill, Strathavon.  
Robroyston.  
Williamwood.**CHITONELLUS, Lamarck.***subquadratus, Kirkby.*  
*Youngianus, Kirkby.*Craigenglen.  
Craigenglen.**DENTALIUM, Linné.***ingens, De Kon.*  
*inornatum, M'Coy.*  
*priscum, Goldf.*First calmy limestone, Carluke.  
Swindridge; Orchard.  
Gare; Orchard; Craigenglen.**EULIMA, Risso.***Phillipsiana, De Kon.*

Orchard; Gare; Craigenglen.

**EUOMPHALUS, Sowerby.***acutus, Sow.*

Bowertrapping; Craigenglen.

*Euomphalus—continued.*

calyx, *Phill.*  
 carbonarius, *Sow.*  
 Dionysii, *Goldf.*  
 marginatus, *M'Coy.*  
 pentangulatus, *Sow.*  
 pileopsideus, *Phill.*  
 pugilis, *Phill.*  
 radians, *De Kon.*  
 tabulatus, *M'Coy.*  
 tuberculatus, *Flem.*

Burtonhead, Stewarton.  
 Orchard; Thornton.  
 Bowertrapping; High Blantyre.  
 Linn Spout.  
 Arden; Bowertrapping.  
 Williamwood.  
 Carmel Water, Kilmaura.  
 Gare; Craigenglen.  
 Linn Spout.  
 Craigenglen.

*LOXONEMA, Phillips.*

brevis, *M'Coy.*  
 clathratula, *Young & Armstrong.*  
 constricta, *Mart.*  
 curvilinea, *Phill.*  
 Lefebvrei, *Lév.*

Gare.  
 Robroyston; Gare.  
 Capelrig.  
 Gare; Robroyston.  
 Beith Quarries; main limestone,  
 Carluke.

polygyra, *M'Coy.*  
 rugifera, *Phill.*  
 scalaroidea, *Phill.*

Cunningham Bedland; Gillfoot.  
 Craigenglen; Hairmyres.  
 Gare; Hairmyres; Robroyston;  
 Craigenglen.  
 Bowertrapping.

sulcatula, *M'Coy.*

*MACROCHEILUS, Phillips.*

acutus, *Sow.*  
 fusiformis, *Sow.*  
 imbricatus, *Sow.*  
 Michotianus, *De Kon.*

Gare; Hairmyres; Craigenglen.  
 Gare; Robroyston; Swindridge.  
 Orchard; Gare; Craigenglen.  
 Robroyston; Gare; Boghead, Ham-  
 ilton.

rectilineus, *Phill.*  
 semistriatus, *Young & Armstrong.*  
 tricinctus, *M'Coy.*

Gare.  
 Orchard; Robroyston.  
 Gare.

*MURCHISONIA, D'Archiac et de Verneuil.*

angulata, *Phill.*  
 elongata, *Portl.*  
 fimbriarinata, *Young & Arm-  
 strong.*

Craigenglen.  
 Gillfoot.

quadricarinata, *M'Coy.*  
 striatula, *De Kon.*  
 subsulcata, *De Kon.*  
 Urei, *Flem.*

Robroyston.  
 Craigenglen; Hairmyres.  
 Orchard; Robroyston; Swindridge.  
 Craigenglen.  
 Boghead, Hamilton; Hairmyres.

*NATICOPSIS, M'Coy.*

canaliculata, *M'Coy.*

Main limestone, Campsie; Boghead,  
 Hamilton.

elliptica, *Phill.*

Craigenglen; in ironstone balls  
 below main limestone, Carluke.  
 High Blantyre; Craigenglen.  
 Arden; Bowertrapping.  
 Gare; Hairmyres; Gillfoot.  
 Swindridge; Lingula ironstone and  
 2d Kingshaw limestone, Carluke.

elongata, *Phill.*

lirata, *Phill.*

plicistria, *Phill.*

Omaliana, *De Kon.*

*Naticopsis*—continued.

*Robroystonensis*, *Young & Armstrong*.  
*variata*, *Phill.*

Robroyston; Gare; Orchard.  
 Bowertrapping; Hairmyres; Craigenglen.

*PLATYCERAS*, *Conrad*.

*angustus*, *Phill.*  
*carinatus*, *M'Coy*.  
*neritoides*, *Phill.*  
*vetustus*, *Sow.*

Gare.  
 Craigenglen.  
 Orchard; High Blantyre.  
 Gare; Bowertrapping; Limekilnburn.

*PLEUROTOMARIA*, *DeFrance*.

*altavittata*, *M'Coy*.

Bowertrapping; Carluke main limestone.

*Benediana*, *De Kon.*  
*carinata*, *Sow.*  
*conica*, *Phill.*  
*contraria*, *De Kon.*

Robroyston; Gare.  
 Robroyston.  
 Gare; Gillfoot; South Hill, Campsie.  
 Capelrig; Boghead, Hamilton; Hairmyres.

*expansa*, *Phill.*  
*Frenoyana*, *De Kon.*  
*Galleottiana*, *De Kon.*  
*monilifera*, *Phill.*  
*multicarinata*, *M'Coy*.  
*ovoidea*, *Phill.*  
*striata*, *Sow.*  
*undulata*, *Phill.*  
*Youngiana*, *Armstrong*.  
*Yvanii*, *Lév.*

Gare; Craigenglen; Beith Quarries.  
 Gare; Orchard.  
 Craigenglen; Hairmyres.  
 Gare; Orchard; Craigenglen.  
 Main limestone, Braidwood.  
 Main limestone, Carluke.  
 Robroyston; Gare; Germiston.  
 Gare.  
 Craigenglen.  
 Boghead, Hamilton; Orchard;  
 Craigenglen.

*TROCHUS*, *Linné*.

*biserratus*, *Phill.*  
*coniformis*, *De Kon.*  
*lepidus*, *De Kon.*

Swindridge; Craigenglen.  
 Arden.  
 Craigenglen; main limestone,  
 Braidwood.

*TURBO*, *Linné*.

*biseriatis*, *Phill.*  
*spiratus*, *M'Coy*.

Broadstone.  
 Roughwood.

**Heteropoda.***BELLEROPHON*, *Montfort*.

*apertus*, *Sow.*  
*cornu-arietis*, *Sow.*  
*decussatus*, *Flem.* et var. *B. striatus*, *Flem.*  
*Duchastelli*, *Lév.*  
*Dumontii*, *D'Orb.*  
*hiulcus*, *Sow.*

Howrat.  
 Main limestone, Carluke.  
 Gare; Robroyston; Swindridge.  
 Boghead, Hamilton.  
 Bowertrapping; Craigenglen.  
 Pandearon Burn at Bankside, 1 mile  
 N. of Kilbirnie.  
 Hairmyres.  
 Orchard; Gare.

*Larcomi*, *Portl.*  
*Leveilleanus*, *De Kon.*



**Bellerophon—continued.**

Oldhamii, *Portl.*  
 tangentialia, *Phill.*  
 tenuifascia, *Sow.*

South Hill, Campsie; Thornton.  
 Gare.  
 Gare; Burn, Woodhead, N.E. of  
 Galston.  
 Gare; Orchard; Craigenglen.

Urei, *Flem.*

POBCELLIA, *Léveillé.*  
 armata, *De Verneuil.*

Orchard; Craigenglen; Craigie.

**Pteropoda.**

So far as yet discovered this class is represented by only one genus and species in our Carboniferous strata, viz. *Conularia*, which ranges from the Lower to the Upper Limestone group, but is rare in most localities. Finely preserved specimens of this shell are met with in the shale that lies over the Orchard and Arden cement limestones near Thornliebank and Pollokshaws; it is also met with in the shales at Robroyston, and Gare near Carlisle.

**CONULARIA, Miller.**

quadrisulcata, *Sow.*

Boghead, Hamilton; Gare; Robroyston.

**Cephalopoda.**

This highest class of the Mollusca is represented by six genera, and a considerable number of species, that range from the lower to the upper group of limestones, the greatest number of species being found in the upper beds. Remains of large *Nautili*, *Actinoceras*, *Orthoceras*, and *Poterioceras* are found in the limestones, chiefly in the form of casts. The best preserved specimens, however, are those found in the limestone shales, these having the outer shell often well preserved; some of the *Orthoceratites* still showing the remains of chevron-shaped bands of colour.

**ACTINOCERAS, Bronn.**

giganteum, *Sow.*

Orchard, instructive examples, showing large beaded siphuncle.

**CYRTOCERAS, Goldfuss.**

Gesneri, *Mart.*  
 rugosum, *Flem.*  
 unguis, *Phill.*

Gare; Robroyston; Craigenglen.  
 Orchard; Hairmyres; Craigenglen.  
 Gare; Orchard; Craigenglen.

**GONIATITES, De Haan.**

diadema, *Goldf.*  
 excavatus, *Phill.*  
 Gibsoni, ? *Phill.*  
 Gilbertsoni, *Phill.*  
 implicatus, *Phill.*  
 Looneyi, *Phill.*  
 micronotus, *Phill.*  
 mutabilis, *Phill.*  
 paucilobus, *Phill.*  
 reticulatus, *Phill.*

Craigenglen.  
 Gare; Robroyston.  
 Gare.  
 South Hill, Campsie.  
 Robroyston; Gare.  
 Boghead, Hamilton; Raes Gill.  
 South Hill, Campsie.  
 Robroyston; Gare.  
 Robroyston; Gare.  
 Gare; above calmy limestone in  
 nodules; Raes Gill.  
 Corrieburn; Gare.

sphaericus, *Mart.*

**Goniatites**—*continued*.

*striatus*, *Sow.*  
*striolatus*, *Phill.*  
*vesica*, *Phill.*

Gare; South Hill, Campsie.  
 Robroyston; Auchinbeg; Gare.  
 Gare; Robroyston; Auchinbeg.

**NAUTILUS**, *Breynius*.

*biangulatus*, *Sow.*  
*dorsalis*, *Phill.*  
*globatus*, *Sow.*  
*ingens*, *Mart.*

Gare.  
 Castlecary.  
 Gare; Orchard; Arran.  
 Castlecary; Arden.

(Discites) *Leveilleanus*, *De Kon.* High Blantyre; main limestone, Carluke.

*nodiferus*, *Armstrong.*  
 (Discites) *quadratus*, *Flem.*

Gare; Arden.  
 Orchard; Boghead, Hamilton; Thornton.

(Discites) *sulcatus*, *Sow.*  
*tuberosus*, *M'Coy.*

Corrieburn.  
 Castlecary; Auchinbeg.

**OTHOCERAS**, *Breynius*.

*attenuatum*, *Flem.*  
*Breynii*, *Mart.*  
*cinctum*, *Sow.*  
*cylindraceum*, *Flem.*  
*dentaloideum*, *Phill.*  
*dilatatum*, *De Kon.*  
*Goldfussianum*, *De Kon.*  
*laterale*, *Phill.*  
*læve*, *Flem.*  
*lineale*, *De Kon.*  
*mucronatum*, *M'Coy.*  
*ovale*, *Phill.*  
*Muensterianum*, *De Kon.*  
*pygmæum*, *De Kon.*  
*subcentrale*, *De Kon.*  
*undatum*, *Flem.*

Gare; Orchard; Craigenglen.  
 High Blantyre.  
 Gare; South Hill, Campsie.  
 Gare; Craigenglen.  
 South Hill, Campsie.  
 Gare; Corrieburn.  
 South Hill, Campsie; Gare.  
 Craigenglen.  
 Boghead, Hamilton.  
 Balgrochen Glen, Campsie.  
 Gare.  
 Orchard; Gare.  
 South Hill, Campsie.  
 Gare; South Hill, Campsie.  
 Orchard; Gare.  
 Boghead, Hamilton; Craigenglen; Thornton.

**POTERIO CERAS**, *M'Coy.*

*cordiforme*, *Sow.*  
*fusiforme*, *Sow.*  
*ventricosum*, *M'Coy.*

Craigie, Kilmarnock.  
 Calderwood cement.  
 Arden; High Blantyre; main limestone, Carluke.

In closing our remarks upon the Mollusca of our Carboniferous strata, there are some points that are interesting as regards the distribution of the group, and which may be worth mentioning, viz. that on certain horizons of strata in both the Lower and Upper Limestone series there is an associated group of shells which always appear in certain of the limestone shales and clay ironstones, and sometimes in the calmy or cement limestones. The following genera are the most characteristic of this group, viz. *Nucula*, *Leda*, *Arca*, and *Cypricardia* amongst the bivalves; *Pleurotomaria*, *Murchisonia*, *Euomphalus*, *Macrocheilus*, *Naticopsis*, *Loxonema*, *Dentalium*, and *Bellerophon* amongst the univalves; and *Nautilus*, *Cyrtoceras*, *Orthoceras*, and *Goniatites* amongst the chambered shells. In the strata in which the

foregoing group occurs, remains of Corals, Crinoids, Polyzoa, and the greater number of species of the Brachiopod shells are absent, or at least very rare; while on the other hand, in the strata where this latter group is abundant the foregoing group of Mollusca are rarely met with. It may also be stated that the above genera of Mollusca are generally absent in the purer limestones, or are represented when present by other species that are never abundant, and that do not appear in the shales. An examination of any of the collections of the Mollusca from the Carboniferous strata of the West of Scotland will show at a glance that all the genera we have named are chiefly derived from the shale beds of the limestone series. Had we depended solely upon the Mollusca found associated with the Encrinal, Coralline, and Productal limestones, our list of species would have been poorly represented. This being the case, it shows that this grouping of the molluscan and other marine faunas of the Scottish Carboniferous sea bottom has in all probability depended greatly upon the depth of water, temperature, and nature of the sediments which were being deposited. The reappearance at wide intervals and in several horizons of strata of certain groups of molluscan life shows clearly that certain conditions of the sea bottom were requisite for their growth and development. It also, on the other hand, shows that these conditions were not so favourable for the growth of Corals, Crinoids, Polyzoa, and many of the Brachiopods.

#### PISCES.

The remains of fishes extend from the lower beds of the Calciferous series, up through the several divisions of the limestone strata, Middle Coal and Ironstone, Millstone Grit, and Upper Coal Measures. Two groups are represented, viz. Lepidogonoid and Plagiostomous fishes. The former are chiefly confined to the fresh or brackish water strata, being very rarely met with in any of the beds of purely marine origin. The remains of the Plagiostomous fishes, on the other hand, are found in both the marine and fresh-water strata, certain genera being peculiar to each of these groups.

Nearly all of the larger Ganoid fishes are found in detached fragments, consisting of scales, teeth, vertebrae, and other harder parts of their skeletons. Only in a few instances have any considerable portion of these larger fishes been preserved in any of our beds. In some of the blackband ironstones and bituminous shales several of the smaller Ganoid fishes, such as *Palæoniscus*, are met with having their form pretty entire, but in general these smaller fishes are met with in the strata as scattered scales and teeth. This remark applies equally to the Plagiostomous fishes, large and small, their remains always occurring in a broken up and scattered condition in the strata in which they are found.

#### Selachians.

##### CARCHAROPSIS, *Agassiz*.

prototypus, *Ag.*

Main limestone, Beith.

##### CHOMATODUS, *Agassiz*.

cinctus, *Ag.*

Shale, Drumgray coal, Carluke.

clavatus, *Ag.*

Brockley.

linearis, *Ag.*

Tirfergus Glen, Campbeltown.

obliquus, *Ag.*

Carluke with *C. cinctus*.

- CLADODUS**, *Agassiz*.  
*conicus*, *Ag.*  
*lævis*, *M'Coy*.  
*Milleri*, *Ag.*  
*mirabilis*, *Ag.*  
*parvus*, *Ag.*  
*striatus*, *Ag.*  
 Shale, Drumgray coal, Carluke.  
 Airdrie blackband.  
 Howrat.  
 Main limestone, Beith; Sculliongour.  
 Shale, Drumgray coal, Carluke.  
 Howrat; blue and white limestones, Beith.
- COCHLIODUS**, *Agassiz*.  
*acutus*, *Ag.*, v. *Deltotychius*  
*acutus*, *Ag.*  
*compactus*, *Owen*.  
*contortus*, *Ag.*  
*magnus*, *Ag.*, v. *Tomodus convexus*, *Ag.*  
*striatus*, *Ag.*, v. *Xystrodus striatus*, *Ag.*  
 Main limestone, Beith.  
 Blue and white limestones, Beith.
- CTENACANTHUS**, *Agassiz*.  
*brevis*, *Ag.*  
*hybodontoides*, *Ag.*  
*major*, *Ag.*  
*tenuistriatus*, *Ag.*  
 Splint coal, Shettleston; Drumgray coal, Carluke.  
 Shale, Drumgray coal, Carluke.  
 Palace Craig ironstone, Carnbroe.  
 Shale, Drumgray coal, Carluke.
- CTENOPETALUS**, *Agassiz*.  
*serratus*, *Ag.* (*Ctenoptychius serratus*, *Ag.*).  
 Blue and white limestones, Beith.
- CTENOPTYCHIUS**, *Agassiz*.  
*apicalis*, *Ag.*, v. *Petalodus apicalis*, *Barkas*.  
*dentatus*, *Ag.*, v. *Harpacodus dentatus*, *Ag.*  
*denticulatus*, *Ag.*  
*pectinatus*, *Ag.*  
*serratus*, *Ag.*, v. *Ctenopetalus serratus*, *Ag.*  
 Climpy pits near Wilsontown.  
 Palace Craig ironstone, Carnbroe.
- DELTODUS**, *Newberry and Worthen*.  
*sp.*  
 Shale above Lower coal, and white limestone, Beith.  
*sp.*  
 Raes Gill shale, Hallcraig, Carluke.
- DELTOPTYCHIUS**, *Agassiz*.  
*acutus*, *Ag.* (*Cochliodus acutus*, *Ag.*).  
 Beith Quarries, in several limestones.
- DIPLODUS**, *Agassiz*.  
*gibbosus*, *Ag.* (*Pleuracanthus gibbosus*, *Ag.*).  
 Palace Craig ironstone, Carnbroe.
- GLOSSODUS**, *M'Coy*.  
*marginatus*, *M'Coy*.  
 Blue and white limestones, Beith.
- GYRACANTHUS**, *Agassiz*.  
*formosus*, *Ag.*  
*tuberculatus*, *Ag.*  
 Shale, splint-coal, Cambuslang.  
 Airdrie and Quarter blackband.
- HARPACODUS**, *Agassiz*.  
*dentatus*, *Ag.* (*Ctenoptychius dentatus*, *Ag.*).  
 Quarter blackband.

- HELODUS, Agassiz.**  
*didymus, Ag.* Blue and white limestones, Beith.  
*lævissimus, Ag.* Shale, Drumgray coal, Carluke.  
*mammillaris, Ag.* Gare; Shiells; Auchenskeoch.  
*planus, Ag., v. Psephodus magnus, Ag.* Shale, Drumgray coal, Carluke.  
*simplex, Ag.*
- HOMOCANTHUS, Agassiz.**  
*microdus, Ag.* Main and blue limestones, Beith.
- LEPTACANTHUS, Egerton.**  
*Jenkinsoni, M'Coy.* Clayband, High Blantyre.  
*junceus, M'Coy.* Blackband, Dalry.
- ONCHUS, Agassiz.**  
*sp.* Drumgray coal, Carluke.
- ORACANTHUS, Agassiz.**  
*Milleri, Ag.* Roughwood.  
*minor, Ag.* Langside, Beith.
- ORODUS, Agassiz.**  
*cinctus, Ag.* Coral-shale band, Beith.  
*sp.* Gillfoot, in shale above limestone.
- ORTHACANTHUS, Agassiz.**  
*cylindricus, Ag.* Shale, splint-coal, Newton.
- PETALODUS, Owen.**  
*apicalis, Barkas (Ctenoptychius apicalis, Ag.).* Shale, Drumgray coal, Carluke.  
*Hastingsia, Owen.* Beith Quarries; High Blantyre.  
*lobatus, Ether.* Crosshouse.  
*psittacinus, Ag., v. Petalorhynchus psittacinus, Ag.*  
*rectus, Ag., v. Polyrhizodus radicans, Ag.*  
*sagittatus, Ag., v. Petalorhynchus psittacinus, Ag.*
- PETALORHYNCHUS.**  
*Benniei, Ether.* Shiells; Auchenskeoch; Trearne.  
*psittacinus, Ag. (Petalodus psittacinus, Ag.).* Auchenskeoch, Crosshouse.
- PETRODUS, M'Coy.**  
*patelliformis, M'Coy.* Robroyston.
- PHYSONEMUS, Agassiz.**  
*sp.* Main and blue limestones, Beith.
- PLEURODUS, Agassiz.**  
*affinis, Ag.* Palace Craig ironstone, Airdrie.  
*Rankinii, Ag.* Shale, Drumgray coal, Carluke.
- PŒCILODUS, Agassiz.**  
*aliformis, Ag.* Auchenskeoch; Boghead, Hamilton.  
*angustus, Ag.* Shale, Drumgray coal, Carluke.  
*Jonesii, Ag.* Braehead Quarry.  
*obliquus, Ag.* Carluke, with *P. angustus*; Beith, in several limestones.

<b>POLYRHIZODUS</b> , <i>M'Coy</i> .	
pusillus, <i>Ag.</i>	Auchenskeoch.
radicans, <i>Ag.</i> ( <i>Petalodus rec-</i> <i>tus</i> , <i>Ag.</i> ).	Craigenglen.
<b>PSAMMODUS</b> , <i>Agassiz</i> .	
porosus, <i>Ag.</i>	High Blantyre; Beith Quarries.
rugosus, <i>Ag.</i>	Beith Quarries.
<b>PSEPHODUS</b> , <i>Agassiz</i> .	
magnus, <i>Ag.</i> ( <i>Helodus planus</i> , <i>Ag.</i> ).	Beith Quarries.
<b>TOMODUS</b> , <i>Agassiz</i> .	
convexus, <i>Ag.</i> ( <i>Cochliodus mag-</i> <i>nus</i> , <i>Ag.</i> ).	Beith Quarries; High Blantyre.
<b>TRISTYCHIUS</b> , <i>Agassiz</i> .	
arcuatus, <i>Ag.</i>	Woodside pits, west of Glasgow (1887).
? minor, <i>Ag.</i>	Mosshat Burn, Wilsontown; Hurlet.
<b>XYSTODUS</b> , <i>Agassiz</i> .	
striatus, <i>Ag.</i> ( <i>Cochliodus stria-</i> <i>tus</i> , <i>Ag.</i> ).	White limestone, Beith.
sp.	Shale above Lower Coal, and white limestone, Beith.
<b>Rays.</b>	
<b>JANASSA</b> , <i>Hancock and Athey</i> .	
imbricatus, <i>H. &amp; A.</i> ( <i>Climaxodus</i> <i>imbricatus</i> , <i>Ag.</i> ).	Shale, Drumgray coal, Carluke.
<b>Ganoids.</b>	
<b>ACANTHODES</b> , <i>Agassiz</i> .	
sulcatus, <i>Ag.</i>	Shale, Drumgray coal, Carluke.
Wardi, <i>Ag.</i>	Palace Craig blackband, Carnbroe.
<b>ACROLEFIS</b> , <i>Agassiz</i> .	
sp.	Browntod Quarry.
sp.	Shale, Drumgray coal, Carluke.
<b>AMPHICENTRUM</b> , <i>Dr. J. Young</i> .	
granulosum, <i>Dr. J. Y.</i>	Quarter blackband; Shale, lower coal, Beith.
<b>ASTEROLEFIS</b> , <i>Agassiz</i> .	
sp.	Shale, Drumgray coal, Carluke.
<b>CERATODUS</b> , <i>Agassiz</i> .	
sp.	Shale, Virtue Well coal, Carluke.
<b>CORLACANTHUS</b> , <i>Agassiz</i> .	
lepturus, <i>Ag.</i>	Palace Craig blackband, Airdrie.
<b>CTENODUS</b> , <i>Agassiz</i> .	
cristatus, <i>Ag.</i>	Palace Craig blackband, Carnbroe.
imbricatus, <i>H. &amp; A.</i>	
tuberculatus, <i>H. &amp; A.</i>	Quarter blackband; Carnbroe.
<b>CYCLOPTYCHIUS</b> , <i>Huxley</i> .	
sp.	Shale, Drumgray coal, Carluke.
<b>DENDROPTYCHIUS</b> , <i>Huxley</i> .	
sp.	Palace Craig ironstone, Airdrie.

<b>EURYNOTUS</b> , <i>Agassiz</i> . <i>crenatus</i> , <i>Ag.</i>	Craigenglen.
<b>GYROLEPIS</b> , <i>Agassiz</i> . <i>Rankinii</i> , <i>Ag.</i>	Shale, Drumgray coal, and shale Main limestone, Carluke.
<b>MEGALICHTHYS</b> , <i>Agassiz</i> . ? <i>coccolepis</i> , <i>Dr. J. Y.</i> <i>Hibberti</i> , <i>Ag.</i>	Quarter and Airdrie blackbands. Bituminous shales and ironstones in Upper Coal Measures. Quarter blackband.
? <i>rugosus</i> , <i>Dr. J. Y.</i>	
<b>MESOLEPIS</b> . <i>sp.</i>	Shale, Drumgray coal, Carluke.
<b>PALÆONISCUS</b> , <i>Agassiz</i> . <i>Duvernoyi</i> , <i>Ag.</i> <i>Egertoni</i> , <i>Ag.</i> <i>Monensis</i> , <i>Ag.</i> <i>ornatissimus</i> , <i>Ag.</i>	Lower Possil blackband. Shale, Drumgray coal, Carluke. Shale, Drumgray coal, Carluke. Shale, Drumgray coal, and Raes Gill beds, Carluke.
<i>Robisoni</i> , <i>Hibbert</i> . <i>striolatus</i> , <i>Ag.</i>	Shale, Drumgray coal, Carluke. Shale, Drumgray coal, Carluke ; Lower Possil blackband.
<i>Wardi</i> , <i>Hux.</i>	Lower Possil blackband.
<b>PLATYSOMUS</b> , <i>Agassiz</i> . <i>declivus</i> , <i>Ag.</i> <i>parvulus</i> , <i>Ag.</i>	Braehead. Shale, Drumgray coal, Carluke, nearly entire fish.
<b>PYGOPTERUS</b> , <i>Agassiz</i> . <i>sp.</i>	Shale, Drumgray coal, Carluke.
<b>RHIZODOPSIS</b> , <i>Huxley</i> . <i>granulatus</i> , <i>Ag.</i>	Shale, Drumgray coal, Carluke ; Gare; Orchard.
<b>RHIZODUS</b> , <i>Owen</i> . <i>Hibberti</i> , <i>Ag.</i>	Lower Possil blackband ; Dalry blackband.
<i>Portlocki</i> , <i>Ag.</i>	Shale, Drumgray coal, Carluke.
<b>RHOMBOPTYCHIUS</b> , <i>Huxley</i> . <i>sp.</i>	Palace Craig blackband, Airdrie.
<b>STREPSODUS</b> , <i>Huxley</i> . <i>sauroides</i> , <i>Huxley</i> .	Palace Craig blackband.
<b>URONEMUS</b> , <i>Agassiz</i> . <i>magnus</i> , <i>Traq.</i>	Airdrie blackband.

## AMPHIBIA.

The only other class of animals remaining to be noticed are the Amphibians, of which five genera have been provisionally described. So far as yet discovered they seem to be confined to the fresh or brackish water strata, and are found ranging from the Lower Limestone to the higher beds of the Upper Coal Measures, the greatest number of specimens being obtained in connection with some of the blackband ironstones and Entomostracan oil shales. Their

remains generally occur in a broken-up fragmentary condition, but nearly perfect specimens of the skull and lower jaws of several of the species have been met with in one or two localities.

#### Labyrinthodontia.

**ANTHRACOSAURUS**, *Huxley*.

*Russelli*, *Huxley*.

Airdrie and Quarter blackbands.

**LOXOMMA**, *Huxley*.

*Allmanni*, *Huxley*.

Shale, Drumgray coal, Carluke;  
Palace Craig blackband, Carnbroe.

**MEGALERPETON**, *Dr. J. Young and J.*

*Thomson*.

*plicidens*, *Y. & T.*

Quarter blackband.

*simplex*, *Y. & T.*

Quarter blackband.

**PHOLADERPETON**, *Huxley*.

*sp.*

Quarter and Palace Craig blackbands.

**PTEROPLAX**, *Hancock and Athey*.

*cornuta*, *H. & A.*

Quarter blackband; Raes Gill, in ironstone.

### LIST OF LOCALITIES FOR CARBONIFEROUS FOSSILS.

#### Airdrie District.

**CARNBROE.** Ironstone pit, No. 10. Upper Coal Measures.

The roof shale of the Palace Craig ironstone contains *Pholaderpeton*, *Pteroplax cornuta*, *Anthracosaurus Russelli*, *Loxomma Allmanni*, *Megalichthys Hibberti*, *M. coccolepis*, *M. rugosus*, *Acanthodes Wardii*, *Rhomboptychius*, *Strepsodus sauroides*, *Rhizodopsis minor*, *Gyracanthus formosus*, *G. tuberculatus*, *Diplodus gibbosus*, *Ctenacanthus major*, *Cladodus*, *Ctenodus cristatus*, *C. tuberculatus*; also *Anthrapalæmon Grossarti*, *Anthracosia*, and several species of *Lepidostrobus*.

**NEWARTHILL.** Coal and Ironstone pits. Upper Coal Measures.

*Pteroplax cornuta*, *Megalichthys Hibberti*, *M. coccolepis*, *Rhomboptychius*, scales and spines of *Acanthodes Wardii*, *Celacanthus lepturus* in the roof shale of the Palace Craig ironstone; *Anthracosia*, *Anthracoptera*, and fish remains in the shales of the splint and Virtue Well coals, which are nearly wrought out in this district.

**PALACE CRAIG**, 1 mile S. of Airdrie. Ironstone pit.

The same observations apply here as to Carnbroe.

#### Arran.

**CORRIE.** Lower Carboniferous Limestone.

Limestone containing a great abundance of *Productus giganteus*; also a few other Brachiopods, Corals, &c., but as a rule, in an indifferent state of preservation.

**LAGGAN BAY.** Calciferous Sandstone Series.

Erect stumps of large trees, *Lepidophloios*, *Lepidostrobus*, *Lyginodendron*,



&c., showing well-preserved woody structure, and fish remains embedded in hard trappean ash, underlying the Carboniferous Limestone of the island.

**SALT PANS.** Lower Carboniferous Limestone.

Limestone and shale, containing a few Corals, Crinoids, Brachiopods, Lamellibranchs, spiral univalves, Cephalopods, and fish-palates.

**Baillieston.**

**SPRINGHILL COAL PITS.** Upper Coal Measures.

Plants are very abundant in the roof shale, and in ironstone nodules above the Pyotshaw coal. *Alethopteris heterophyllia*, *Cyclopteris dilatata*, *Neuropteris gigantea*, *Pecopteris dentata*, *Sphenopteris dilatata*, *S. Hönigshausi*, *Asterophyllites longifolia*, *A. tuberculata*, *Calamites nodosus*, *Sphenophyllum Schlotheimii*, *Lepidostrobus pinaster*, *Trigonocarpum ovatum*; fish spines in the shales of the splint coal.

**Bathgate District.**

**BALLARDIE,**  $\frac{1}{2}$  mile N. of Bathgate.

Shales exposed in railway cutting containing *Leda attenuata*, *Myacites variabilis*, and *Streptorhynchus crenistria*.

**BLACKBURN,** 2 miles S. of Bathgate.

Limestone and shales, the former with *Actinoceras giganteum*, the latter with several species of *Orthoceras*, *Goniatites* and *Nautilus*, *Bellerophon Uriei*, two species of *Dentalium*, *Loxonema scalaroidea*, *Euomphalus catillus*, *Pleurotomaria monilifera*, *Nucula gibbosa*, *N. longirostris*, *Leda attenuata*, *Griffithides mucronatus*, and *Archæocidaris Uriei*.

**HILLHOUSE QUARRY,** 5 miles N. of Bathgate and 2 miles S.E. of Linlithgow.

Limestone containing several species of corals, and overlaid by basaltic columns.

**KIRKTON, EAST,** 2 miles E. of Bathgate.

Limestone supposed to be of fresh-water origin, in some places laminated and flexured. Some layers have a beautifully mammillated surface. Few traces of fossils are observed. The shales immediately overlying contain plant remains, succeeded by a green ashy friable layer with *Ulodendron minus*, several species of *Lepidodendron*, *Stigmara*, and *Sphenopteris affinis*.

Souler's *Eurypteris* was found at this locality. See Woodward's *Mon. Fossil Merostomata*.

**KIRKTON, WEST,**  $1\frac{1}{2}$  mile E. of Bathgate.

Limestone with *Producti*; shales with *Spiriferæ* and *Psammodus porosus*.

**NORTH MINE QUARRY,**  $2\frac{1}{2}$  miles N. of Bathgate.

Limestone overlaid by marly shale containing *Lithodendron junceum*, *Alveolites*, *Ctenoptychius pectinatus*, *Cochliodus contortus*, and other palatal teeth.

**PETER'S HILL QUARRY,**  $\frac{1}{2}$  mile N.E. of Bathgate.

Limestone 60 or 70 feet thick, very productive of fossils, especially Corals, which are in beautiful preservation. *Lonsdaleia floriformis* exists in large masses, also *Cyathophyllum regium*, *Alveolites depressa*, and *A. septosa*. Ostracoda abound, belonging to the genera *Cyprella*, *Cypri-della*, *Cypridinella*, and *Cypridellina*. Some of the other forms are *Grif-*

*fishides mucronatus*, *Productus giganteus*, *P. Youngianus*, *P. aculeatus*, *Terebratula hastata*, the three varieties, several species of *Aviculopecten*, *Pinna flabelliformis*, *P. spatula*, *Euomphalus Dionysii*, large examples of *Dentalium ingens*, *Tomodus convexus*, *Psammodus porosus*, and several other palatal teeth. The underlying shale contains abundance of *Aviculopecten*, *Pteronites*, and other bivalves; also *Fenestella* and *Rhabdomeson gracile*.

**SOUTH MINE QUARRY**, 2 miles N. of Bathgate.

Fine section of limestone, shales, and sandstone. *Actinoceras giganteum*, magnificent masses of *Cyathophyllum regium*; Brachiopoda are not common, but there are several species of *Aviculopecten*, casts of *Nautilus*, and one or two species of large *Euomphalus*. The shales yield a few plant stems, and the sandstone contains *Cauda-galli*, *Ulodendron*, and annelid burrows.

**SUNNYSIDE QUARRY**, 1½ mile N. of Bathgate.

Limestone with fossils of the same kind as at Petershill, only encrinal remains seem more abundant in some places; the shales and sandstone present no special features other than what are noted at the South Mine Quarry.

**STANDHILL**, ½ mile S. of Bathgate.

Limestone about 6 feet in thickness. *Alveolites*, two species, *Loxonema*, *Nautilus*, and *Orthoceras*.

**WARDLAW QUARRY**, 3 miles N. of Bathgate.

Limestone with *Lithodendron irregulare* and *Streptorhynchus crenistria*, and overlaid by shales and greenstone.

**Beith District.**

**BROADSTONE**, 2 miles S.E. of Beith. Lower Limestone Series.

Thick-bedded limestones and shales, exposed in extensive quarry section. Corals, Crinoids, Polyzoa, Brachiopoda, and fish palates are the prevailing organisms, of which the following are among the more conspicuous:—*Amplexus coralloides*, *Clisiophyllum bipartitum*, *C. turbinatum*, *Cyathophyllum paracida*, *Lithodendron junceum*, *Michelinia tenuisepta*, *Zaphrentis cylindrica*, *Pisocrinus globularis*, *Rhodocrinus uniarticulatus*, several species of Polyzoa in the shales, *Athyris Roysii*, *Orthis Michelini*, *Productus costatus*, *P. fimbriatus*, *P. semireticulatus*, *P. spinulosus*, *Spirifera glabra*, *S. duplicicosta*, *Terebratula hastata*, *Modiola lithodomoides*, *Edmondia rudis*, large *Psammodus rugosus*, *Amphicentrum granulosum*, *Ctenopetalus serratus*, *Tomodus convexus*, *Delloptychius acutus*, *Cladodus mirabilis*, *Petalodus*, and *Helodus*. The fossils are easily extracted from the limestones, but the shales yield the largest number in perfect preservation.

**DOCKRA**, ½ mile from Barr Mill Station. Lower Limestone Series.

Upper beds of Beith section in quarry. Limestone full of Crinoid stems and Brachiopoda; fish palates, such as *Petalodus Hastingsii*, rather abundant; *Psammodus porosus*, rare and very small as compared with specimens found in the lower beds.

**LANGSIDE**, 2 miles S. of Beith. Lower Limestone Series.

Limestone and shale in quarry section, with the same fossils as at Broadstone.

**ROUGHWOOD**, 2 miles S. of Beith. Lower Limestone Series.

Limestone and shale in quarry section very fossiliferous. Two species

of *Palæocoryne*, Corals, Crinoids, several species of Polyzoa, Brachiopoda, *Conocardium*, *Myacites sulcatus*, and *Modiola lithodomoides* common in shale below the main limestone, a bed of *Myalina crassa*, but specimens mostly crushed, large *Psammodus rugosus* and other fish palates, and the massive spine of *Oracanthus Milleri*.

**THIRDPART, 3½ miles W. of Lugton Inn, and 4 miles S.E. of Beith. Lower Limestone Series.**

Limestone and shale, containing the fossils found in the lower bed of the Beith limestones, but they are not so plentiful.

**TREARNE, ½ mile N. of Dockra, and 2 miles S. of Beith. Lower Limestone Series.**

Large quarry, containing the same bed of limestone as at Dockra, but having been longer wrought is a richer field for the fossil-collector. Where the rock has been weathered many fine fish palates, *Athyris* with the spiral arms, crinoid stems and heads, are frequently obtained.

**Bellshill.**

**BELLSHILL. Coal pits between Bellshill and Motherwell. Upper Coal Measures.**

Plant remains in the roof of the Main, and fish remains in the roof of the splint coals.

**Bishopbriggs District.**

**COLTPARK QUARRIES. Upper Limestone Series.**

Cowglen Limestone.—The fossils are not well preserved, but the overlying black shale contains *Goniatites*, small spiral univalves, and *Lingula*. Bishopbriggs Sandstone.—Trunks of *Lepidodendron*, &c. Cement Limestone.—*Orthoceras*, *Pinna*, *Sanguinolites*, and a few Brachiopods in the uppermost thin band.

**IRONSTONE PITS. Lower Coals and Ironstones.**

*Lepidodendron elegans*, Ostracoda, and jaws and scales of *Gyrolepis* in the Upper Fossil blackband ironstone.

**Blantyre District.**

**BROOMHOUSE QUARRY, 1½ mile S. of High Blantyre.**

The beds here are a continuation of the Newfield section. There are several heaps of the upper black shale in different parts of the quarry, and one large mound of the lower gray shale, which is very prolific in the characteristic fossils of the deposit.

**CALDERSIDE, 2 miles S.W. of High Blantyre.**

Calderwood cement mines. The limestone has not been much searched for fossils; it is, however, known to contain some of the larger Cephalopoda, such as *Poterioceras* and *Actinoceras giganteum*. The upper black shale is much thicker here than at Newfield, but neither the gray shale nor the lower bed of limestone is visible in section. There are one or two small hillocks of the former, however, near the bed of the Calder, from which beautiful examples of *Tomodus convexus* have been collected, as well as *Kirkbya Urvii*, in very perfect preservation. The interesting fossil fruit *Trigonocarpum Gloagianum* is found in the upper black shale.

**DYKHEAD, 1½ mile S. of High Blantyre.**

Limestone pit. Same fossils as at Newfield.

**NEWFIELD QUARRY, 1½ mile S. of High Blantyre.**

Depth of section about 30 feet. During the working of the lower bed of limestone within the last few years, fossils, in very perfect keeping, have been obtained from fresh blocks of the superincumbent shale. In other parts of the same section at Boghead, Brankamhall, or Capelrig, are found in a more or less fragmentary condition among the disintegrated material. Branching masses of *Stenopora tumida*, the long prehensile fingers of *Poteriocrinus*, sheets of *Fenestella*, and some of the pinnated forms of Polyzoa, perfect specimens of Trilobites, coiled up or lying extended in the shale, and long pieces of the tubes of *Serpulites*. The typical species of the deposit at this locality, in addition to the foregoing, are:—*Pisocrinus globularis*, *Hydreionocrinus Scotticus*, *Beyrichia bituberculata*, *Kirkbya Uriei*, *Ceripora*, and *Diastopora*, *Athyris ambigua*, *Chonetes Laguessiana*, *Crania quadrata*, *Discina nitida*, *Lingula mytiloides*, *Productus longispinus*, *P. semireticulatus*, *Rhynchonella pleurodon*, *Spirifer lineata*, *S. trigonalis*, *Spiriferina octoplicata*, *Terebratula hastata*, *Edmondia rudis*, *Axinus axiniformis*, *Myacites sulcata*, *Sanguinolites variabilis*, *Aviculopecten fimbriatus*, *Pecten Sowerbii*, *Pleurotomaria contraria*, *Murchisonia Uriei*, *Orthoceras læve*, *Petalodus Hastingsæ*, and *Tomodus convexus*.

**Cadder District.****IRONSTONE PITS ON BANKS OF FORTH AND CLYDE CANAL. Lower Coals and Ironstones.**

Fossils of the Upper Possil blackband ironstone.

**Caldwell.****NETHERTON, 1 mile S. of Caldwell Station, Glasgow and Kilmarnock Direct Railway. Lower Coals and Ironstones.**

Ironstone pits. Brachiopoda and fish remains in the shales.

**Campbeltown.****TIERFERGUS GLEN, 4 miles S.W. of Campbeltown. Lower Limestone Series.**

Section of sandstone, bituminous shale and limestone, with a considerable number and variety of fossils.

**Campsie District.****BALGROCHAN BURN, ¼ mile N. of Lennoxtown. Lower Limestone Series.**

A very limited exposure of a bed of limestone, almost entirely made up of the crushed shells of *Spirifera duplicita*, shale with clay ironstone nodules containing a few species of Brachiopoda, and the rare *Orthoceras lineale*. These beds underlie the main limestone of the Campsie valley, and are believed by Mr. Young to be the equivalents of the "shelly" limestone of the Carlisle district.

**BALGLASS BURN, ¼ mile S.W. of Lennoxtown. Lower Limestone Series.**

An outcrop in the bed of the stream, of ironstones and shales, beneath the Campsie main limestone. Crinoid stems and prehensile fingers, *Serpulites*, Trilobites, Brachiopoda, and *Psammodus porosus*.

**BALDERNOCK LINN, 3 miles S.W. of Lennoxtown. Lower Limestone Series.**

Estuarine or fresh-water limestone lying under bedded trap, containing Ostracoda and fish remains.

**BALLAGAN GLEN, 3½ miles N.W. of Lennoxtown. Ballagan Limestone Series.**

*Lepidodendron* and other plant remains, with obscure annelid-like markings, found in a gray flaggy sandstone.

**CRAIGENGLEN, 2 miles S. of Lennoxtown. Lower Limestone Series.**

Sandstone, limestone, clay ironstone, and limestone shale. Fish palates, *Orthoceratites*, some with coloured bands, spiral univalves, Lamellibranchiata, Brachiopoda, Polyzoa, Entomostraca, Annelida, Echinidæ, Crinoidæ, Corals, and Foraminifera, in the limestone and shale, and fish opercula and scales in the Entomostracan oil shale. The strata of this locality, among those in the Lower Limestone series of the West of Scotland, contain the greatest assemblage of species, and which exist in the most perfect state of preservation. Some of the more striking fossils are, the Melania-looking *Loxonema rugifera*, a magnificent spiral, *Macrocheilus imbricatus*, *Venus elliptica*, *Modiola megaloba*, *Cypricardia striato-lamellosa*, *Cardiomorpha oblonga*, *Azinus aziniformis*, *Arca reticulata*, *Terebratula hastata* showing the intimate shell-structure, *Productus punctatus*, and *Spirifera Urvii*, both frequently covered with their delicate spines, and the complete detached parts of *Archæocidaris Urvii*. It is the only locality which has yielded the plates of *Chitonellus*. Some of the fossils, although perfect, are too fragile to be removed from their matrix in the shale, but may be rendered perfectly secure by a little careful manipulation. This is especially so with the valves of *Aviculopecten* and many of the other Conchifera.

**CRAIGMADDIE MUIR, near "Auld Wives' Lifts," 3½ miles S.W. of Lennoxtown. Lower Limestone Series.**

A bed of marine limestone in an old opening under the sandstone of the hill has yielded a few Brachiopods and Crinoid remains. A few plants have been found in the sandstone at various points on the hill, but they are rare.

**FINTRY HILLS, near the Corrie of Balglass. Ballagan Limestone Series,**

Plant remains in a gray flaggy sandstone.

**MILL BURN, ½ mile N.E. of Lennoxtown. Lower Limestone Series.**

Marine limestone, clay ironstone, and fresh-water limestone, underlying the main limestone of the Campsie district. Teeth, spines, and other fish remains, *Lingula squamiformis* abundant in one of the shales, *Productus giganteus* and *Chonetes Buchiana* in the limestone, but very rare; also a few bivalves and corals, and Entomostraca in the fresh-water limestone.

**SOULLIONGOUR, 1 mile N. of Lennoxtown.**

Limestone and shale in quarry section, containing the crushed tests of *Archæocidaris Urvii* with spines *in situ*, *Serpulites*, Brachiopoda, *Aviculopecten*, *Nautilus*, *Goniatites*, *Cladodus mirabilis*, and scales of *Rhizodus*.

**SOUTH HILL, Campsie. Old ironstone pit, 1 mile S.W. of Lennoxtown. Lower Limestone Series.**

This locality is now obliterated. For many years a shale which had been brought up in sinking the pit shaft to the Hosie limestone, which it

directly overlies, yielded to collectors a large variety of fossils, but a few years back operations were resumed for working both the limestone and the clay ironstone beneath it, and the unfossiliferous shales accompanying the latter have been brought to the surface, and piled on the top of the fossil-bearing shale, which will probably lie buried for ever under this mass of unproductive rubbish. The same shale was brought up in the sinking of a pit at Barraston, and in another to the north-west of it, and similarly treated. Collectors should therefore carefully watch the sinking of other pits along the plateau of the South Hill, for the shale in question contains a large number of rare and beautiful fossils, some of which, as casts, are coated with the sulphuret of iron, which gives them a fine metallic lustre. The following are among the more typical forms:—*Nautilus quadratus*, rarely perfect, but not uncommon in pieces, some containing the body chamber and sinuated aperture; *Orthoceras cinctum*, *O. pygmaeum*, *Goniatites Gilbertsoni*, *G. vesica*, *Bellerophon Oldhami*, *Pleurotomaria conica*, var. *decussata*, *Dentalium priscum*, *Nucula luciniformis*, *N. lineata*, *Leda longirostris*, *L. attenuata*, *Spirifera Uris*, *Chonetes Laquessiana*, var., and *Polycope Youngiana*.

Strata on the same horizon are exposed between East Kilbride and Busby.

#### Carlisle District.

##### BASHAW, 2 miles N.E. of Carlisle.

Gare limestone, old workings on north side of dyke; main limestone on the other; formerly wrought, but pit now closed.

##### BELSTON BURN, 1½ mile N.E. of Carlisle. Upper Limestone Series.

Belston Burn limestone. Open section by side of private railway near the end of the cutting nearest Castlehill, and in an exploratory pit at the same place; *Griffithides Eichwaldi*, *Athyris ambigua*, *Lingula squamiformis*, *Orthis resupinata*, *Rhynchonella pleurodon*, *Streptorhynchus crenistria*, *Aviculopecten*, *Pteronites*, *Conularia*, *Eumphalus*, *Productus latissimus* is found above a small coal seam, in clusters oddly folded on each other. The fossils are in bad keeping in soft, dark shale, but distinct, and can be easily preserved by careful manipulation.

##### BELSTON PLACE BURN, 1½ mile N. of Carlisle. Upper Limestone Series.

Slaty-band ironstone. Open section in burn wrought by day-level mine, but the place is now only noted by shale heaps. The ironstone is a mass of flattened plants, and the shale below much the same. Shells and remains of fishes distinctly pronounced enough, but few in number.

##### BISHOPBENT, 2½ miles S.E. of Carlisle. Lower Limestone Series.

Open-cast working of Raes Gill ironstone. *Glaucanome* and *Fenestella* abundant in the upper surface of one of the plies.

##### BRAIDWOOD GILL, 2 miles S. of Carlisle. Upper Limestone Series.

Maggy ironstones. Open face east of sandstone quarry, considerably above bed of burn.

##### BRAIDWOOD GILL, 2 miles S. of Carlisle. Lower Limestone Series.

The strata exposed in open section at this interesting locality are—  
1. The *Lingula* ironstone beds seen at the Linn below Samson's Slingstone with fossils well preserved, but subject to injury by the shale being sulphurous—pyritic. This stratum, which has yielded many species, is found all over the district, and is passed through in sinking pits to the

Raes Gill ironstones. 2. The *Lingula* limestone, seen in the bed of the burn, 300 or 400 yards below Samson's Slingstone, fossils moderately well preserved. 3. The first calmy limestone, in which fossils are finely preserved, but in some instances difficult to separate from the limestone. 4. Raes Gill ironstone—fossils well preserved, and easily freed from the shales or ironstones. 5. The second calmy limestone, with well-preserved fossils in ironstone balls, but few in the limestone itself. This bed is exposed in open section at Headsmuir, and at one time, when the main limestone was worked, open-cast localities were numerous, but now it is only got at in sinking pits. 6. The main limestone, now wrought in pits over a large semicircle in the district. The fossils, principally shells, are chiefly casts, the more horny species only retaining the shell. A large number of species has been collected from this bed. In the shale below the coal, a foot or more under the lime, *Gyrolepis Rankinii* and some shells are found.

**BROCK'S HOLE, 1 mile E. of Carluke. Upper Limestone Series.**

Maggy ironstones, originally worked by day-level mines, now old shale heaps. *Serpulites membranaceus*, *Productus scabriculus*, *Spiriferina cristata*, var. *octoplicata*, *Streptorhynchus crenistria*, and scales of *Palæonicus* and *Megalichthys*. The fish remains are well preserved, the shells in most instances are thickly-bedded, and are chiefly casts in ironstone.

**CASTLEHILL, 1 mile N. of Carluke. Coal pits. Upper Coal Measures.**

The remains of between forty and fifty species of fishes have been found in the bituminous roof shale of the Drumgray coal at this locality, also remains of the reptile *Loxomma*. *Lepidodendron elegans*, *Lepidostrobus*, and the sporangia of *Flemingites* (?) occur in the ironstone intercalated with the shale. The Kiltongue coal is also wrought, the roof shale of which is full of vegetable remains.

**CHAPEL, 2 miles S. of Carluke. Upper Limestone Series.**

Maggy ironstones, in open face high up the bank above Dud's Well.

**CHAPEL FARMHOUSE, Cliff to the east, on right bank of Fiddler's Burn, and shale on left bank of burn immediately below a ford, about 2½ miles S. of Carluke. Lower Limestone Series.**

Good exposure of *Lingula* limestone. The shale immediately below the limestone contains *Sphenopteris*, *Serpulites carbonarius*, *Dithyrocaris tenuistriatus*, *Lingula squamiformis*, and *Posidonomya corrugata*. The shale over the limestone contains the first three of these fossils, as well as *Chonetes Laguessiana*, *Aviculopecten*, and *Nucula gibbosa*.

**CLEEKHIMIN, 2½ miles S.E. of Carluke. Lower Limestone Series.**

Quarry at Old Farmhouse. Main limestone with Brachiopoda and various species of *Aviculopecten*.

**CROSSFORD, 2 miles S. of Braidwood Station. Lower Limestone Series.**

Limestone and shale in quarry section. Corals, Crinoids, Brachiopoda, and other shells.

**FIDDLER'S BURN, opposite Headsmuir, 1½ mile E.S.E. of Carluke.**

Shale of the main limestone exposed on left bank, containing *Endothyra ammonoides*, *E. Bornmanni*, *E. globulus*, *E. radiata*, *Trochammina incerta*, and *Valvulina palæotrochus*.

**GARE, 2 miles N.E. of Carluke. Upper Limestone Series.**

Old shale heaps at limestone quarry section. The shales of the Gare, of all the localities in the Upper Limestone, are the richest in fossil organisms, of which there are a large number of species in a state of fine preservation. The following may be regarded as the typical forms:—*Stenopora tumida*, *Zaphrentis Phillipsi*, *Palaeacis cyclostoma*, *Pisocrinus globularis*, *Potericrinus crassus*, *Serpulites membranaceus*, *Spirorbis caperatus*, *Leperditia Okeni*, *Griffithides mesotuberculatus*, *Ceriopora*, *Diastopora megastoma*, *Fenestella*, *Athyris ambigua*, *Chonetes Laguessiana*, *Crania quadrata*, *Discina nitida*, *Lingula Scotica*, *L. mytiloides*, *Orthis resupinata*, *Productus longispinus*, *Rhynchonella pugnus*, *Spiriferina octoplicata*, *Streptorhynchus crenistria*, *Strophomena distorta*, *Aviculopecten simplex*, *Arca Lacordaireana*, *Cardiomorpha oblonga*, *Leda attenuata*, *Nucula gibbosa*, *N. laviostrum*, *Conularia quadrisulcata*, *Dentalium priscum*, *Eulima Phillipsiana*, *Loxonema curvilinea*, *L. scalaroidea*, *Macrocheilus Michotianus*, *Pleurotomaria monilifera*, *P. contraria*, *P. Benediana*, *Platyceras vetustus*, *Bellerophon Urii*, *B. Leveilleanus*, *Actinoceras giganteum*, *Cyrtoceras Gesneri*, *C. unguis*, *Goniatites Gibsoni*?, *G. striolatus*, *Nautilus globatus*, *N. nodiferus*, *N. quadratus*, *Orthoceras attenuatum*, *O. subcentrale*, and the scales of *Rhizodopsis minor* and *Gyrolepis Rankinii*, in small ironstone nodules. There are also a large number of species, some exceedingly rare, belonging to the various groups of which these, at this locality, may be considered as the representatives. The variety of crinoid stems and their condition at once excite the attention of the collector who for the first time explores the shale heaps of the Gare. While some retain their markings as perfect as in the living state, others are swollen from injuries received while living, or bear parasites, such as *Crania*, *Diastopora*, and the circular bird's-nest-looking coral *Palaeacis cyclostoma*, or like the limestone pebbles of the East Kilbride shale, they are covered with round holes, the work of some spiral mollusk? The shells are in a beautiful state of preservation, and many of them seem to have served as the nuclei of ironstone nodules.

**GARRISON GILL, 2½ miles N.N.W. of Carluke. Upper Coal Measures.**

Bellside ironstone, bituminous shale and light brown ironstone in open section.

**GATESIDE, near Kilcadzow, 2 miles E.S.E. of Carluke. Lower Limestone Series.**

Raes Gill ironstone in open section at old quarry.

**GILLHEAD BRIDGE, 2½ miles N.N.W. of Carluke. Upper Coal Measures.**

Kiltongue mussel-band in bed of burn, containing *Anthracosia* and fish remains.

**GILLFOOT, 2½ miles S.S.W. of Carluke. Upper Limestone Series.**

Belston Burn limestone and shale. Open section in a small stream. This section has lately been well explored, and the fossils are reported to be numerous and well preserved. Upwards of 100 species have been found, including *Eoscorpius*.

**HALLCRAIG BRIDGE, 1¼ mile W. of Carluke. Lower Limestone Series.**

The strata at this locality are—the *Lingula* limestone, seen in the burn below the bridge, and in an open section ¼ mile S., in a small stream, with well-preserved fossils; the first Kingshaw limestone, with fossils in soft shale above and below the limestone, in the burn and railway side, in open section, but not well adapted for preservation; the second Kingshaw lime-



stone, with fossils, as in the first Kingshaw, but particularly in the shale below the limestone. These are also in the same condition, although some of the *Natica* and *Pleurotomaria* are well preserved, and leave the shale freely.

**HEADSMUIR**, 1½ mile S.E. of Carluke. Lower Limestone Series.

First calmy limestone in open section of old workings.

**HILLHEAD**, 1 mile E. of Carluke. Lower Limestone Series.

This locality is inserted simply to record the existence of the Raes Gill ironstone and the Hosie limestone, above which the first specimen of *Spirifera Carlukenensis* was found. The old workings of the former are long disused, and the section of the latter is obliterated by an overslip of earth.

**KILCADZOW**, 3 miles E. of Carluke. Lower Limestone Series.

The beds at this locality are—Raes Gill ironstone, worked open-cast, and the second calmy and main limestones, exposed in open section.

**KINGSHAW**, 1 mile N.E. of Carluke. Lower Limestone Series.

The first and second Kingshaw limestones occur here, but both are now lost sight of, except in the ironstone pits.

**LANGSHAW**, 1 mile S.E. of Carluke. Lower Limestone Series.

Second Kingshaw limestone worked in pits, first calmy limestone in open section, the Raes Gill ironstones in open section and in pits, and the main limestone worked in mines.

**LANGSHAW BURN**, 1 mile S.E. of Carluke. Lower Limestone Series.

*Lingula* limestone, seen in the bed of the burn and in pits.

**LAW**, 2 miles N.W. of Carluke. Coal pits. Upper Coal Measures.

Fish remains in the roof shales of the splint and Virtue Well coals.

**LEE MUIR**, 1½ mile S.E. of Carluke. Lower Limestone Series.

Open-cast working of Raes Gill ironstone, east of old limestone quarry. *Serpulites carbonarius*, *Orthoceras*, sp., &c.

**MAYFIELD**, about 1 mile S.E. of Carluke. Lower Limestone Series. Ironstone and limestone pit.

*Pecten Sowerbii*, *Bellerophon*, *Natica plicistria*, in shale above second Kingshaw limestone.

**MILTON LOCKHART PIT** (Merry and Cunningham's), about ¾ mile S.W. of Carluke. Lower Limestone Series.

Shale above second Kingshaw limestone, containing *Fenestella* and *Glaucanome*, *Crania*, *Lingula*, *Aviculopecten micropterus*, *A. ornatus*, *A. oryza*, *A. simplex*, *Macrochilus imbricatus*, and *Conularia quadrimaculata*.

**NELLFIELD BURN**, 2 miles S.E. of Carluke. Lower Limestone Series.

Outcrops of the "shelly" and *Productus* limestones, the former at the Linn in the bed of the burn near Langshaw March, the latter farther up the burn at a second Linn; and in the bed of the burn directly south of Nellfield Farmhouse, and on the side of the railway embankment and tunnel, lower side, occur the *Productus punctatus* ironstone beds, which are the lowest in the Carluke district in which Brachiopoda have been found.

**RAES GILL, 2 miles W. of Carluke. Lower Limestone Series.**

The strata of this locality are—the *Lingula* limestone, seen at the outcrop in a small stream south of Hallcraig Bridge; the first calmy limestone seen in open face at an old working, but here it is only about 15 inches in thickness, while elsewhere in the district it is from 4 to 5 feet; the Raes Gill ironstones, seen in open cast and in old shale heaps; and the Hosie limestone, but it is covered up by shale through displacement of the banks.

**SKITRIDGE GILL, 2 miles S. of Carluke. Upper Limestone Series.**

Maggy ironstones. Open section from below the Linn.

**THORN, 1 mile N.E. of Carluke. Lower Limestone Series.**

Open section of the main limestone, above which runs a bed, often converted into ironstone balls, loaded with *Archæocidaris Urvii*. The old workings of the Hosie, second calmy, and main limestones at Mosside, a few hundred yards to the west, are now closed up.

**WAYGATESHAW, 1½ mile S.S.W. of Carluke. Lower Limestone Series.**

First calmy limestone in open section; Raes Gill ironstone worked in pits and open-cast, fossils in old shale heaps; Hosie limestone passed through in pits; main limestone worked by pits. Pit to main limestone near Oldhill Farmhouse. *Aviculopecten ornatus*, *Pteronites fluctuosus*.

**WESTERHOUSE, 3 miles E.N.E. of Carluke. Upper Limestone Series.**

The Gare limestone and shales, and a good locality. It is about a mile directly to the eastward of Gare, and is reached by crossing over King's Law, and keeping by the side of a wire fence, which extends nearly to the old quarry openings.

**WILTON IRONSTONE PIT (Coltness Iron Co.), 1 mile S.E. of Carluke.**

Shale heaps from Raes Gill ironstone. *Archæocidaris Urvii*, *Syncladia*, *Aviculopecten interstitialis*, *A. micropteris*, *Euomphalus catillus*, *Pleurodus Rankinii*.

**WHITESHAW, ¼ mile W. of Carluke. Upper Limestone Series.**

The Gare limestone, formerly worked by pits, but this locality is all but turned to agricultural purposes, and may be soon obliterated altogether. The occurrence of this lime at Whiteshaw is only important in a physical sense. A huge dyke brings the Gare beds back to the west, or throws them on to the east above 100 fathoms.

**WHITESHAW BRIDGE, 1 mile W. of Carluke. Upper Limestone Series.**

Maggy ironstones, seen in the bed of the burn and in side of railway cutting.

**YUILDSHIELS, 2 miles E. of Carluke. Lower Limestone Series.**

Outcrop of the *Productus* limestone, close on the Old Red shales on south bank of the burn; section pretty much earthed up.

**Carmyle.****COAL PIT NEAR CARMYLE MILL. Upper Coal Measures.**

Ferns in an arenaceous shale, and *Gyracanthus formosus*, *Diplodus gibbosus*, *Pleurodus*, and *Ctenoptychius pectinatus*, in a bituminous shale, overlying the splint coal.

**Castlecary.****LIMESTONE PITS, close to the Railway Station. Upper Limestone Series.**

The characteristic fossils of this limestone are, *Actinoceras giganteum*, *Nautilus ingens*, *N. dorsalis*, *Orthis resupinata*, *Productus semireticulatus*, and *P. punctatus*. It also contains *Productus undatus*, *Posidonomya vetusta* and *Azinus aziniformis*, but these are very rare. As a rule the specimens attain larger dimensions than is usual in the limestones of the west of Scotland.

**Cumnock.****MUIRFOOT BURN, near New Cumnock Station. Upper Limestone Series.**

Sections of ironstone, limestone, and shale. *Bellerophon Dumontii*, *B. Uriei*, *Leda*, *Nucula*, *Edmondia*, *Avicula*, *Aviculopecten duplicicosta*, *Rhynchonella pugnus*, *Orthis resupinata*, *Chonetes Laguessiana*, *Lingula mytiloides*, and *Discina nitida*.

**Dalry District.****AUCHENMADE QUARRY, 3½ miles S.E. of Dalry, on road to Stewarton, by Bowertrapping Farm. Lower Limestone Series.**

Limestone and shale. Cup corals, masses of *Lithodendron*, Crinoids, Polyzoa, Brachiopoda, teeth of *Cochliodus*, *Petalodus*, and fish-bones.

**AUCHENSKEBOCH QUARRY, 2½ miles S.E. of Dalry. Lower Limestone Series.**

Extensive section of limestone and shale. The former contains many species of Brachiopoda and the usual fossils found in the lower limestones of Northern Ayrshire, while the shales are remarkably profuse in large cup corals, Crinoids of several species, Polyzoa, Brachiopoda, and fish palates. The more common are—*Syringopora ramulosa* in thin bands in the shale, *Heterophyllia angulata*, *Amplexus Henslowi*, crushed tests of *Archæocidaris Uriei*, *Poteriocrinus*, the long slender tubes of *Hyalonema parallelum*, *Ceripora interporosa*, *Polypora papillata*, *Sulcoretopora parallela*, *Vincularia*, *Streptorhynchus crenistria*, which may be said to be the prevailing Brachiopod, its compressed valves crowded over each other on nearly every slab of shale, a few bivalves, spiral shells, and Cephalopoda, *Cochliodus*, *Petalodus*, *Petalorhynchus* (?) *Benniet*, and other palatal teeth. Pieces of *Dadoxylon* are found in the coal beneath the lower bed of limestone.

**BARKIP, 3 miles E. of Dalry. Coal and ironstone pits and sandstone quarries. Lower Coals and Ironstones.**

Teeth of *Rhizodus*, spines of *Gyracanthus*, and teeth of *Cladodus* in the blackband ironstone; plant remains in the sandstone.

**BOMBO FALLS, 1 mile E. of Dalry Station. Upper Limestone Series.**

Shale below Bowertrapping limestone, containing *Macrocheilus*, *Bellerophon*, *Pleurotomaria*, *Dentalium*, *Azinus*, *Cypricardia*, and *Arca*.

**BOWERTRAPPING. Limestone quarry 3 miles N.E. of Dalry, near Wheaty-faulds ironstone pit. Upper Limestone Series.**

Limestone. Brachiopoda, about twenty species, the most characteristic being *Terebratula hastata*, var. *vesicularis*, *Athyris ambigua*, *Spirifera trigonalis*, *S. Uriei*, *Rhynchonella pugnus*, *Orthis resupinata*, *Streptorhynchus crenistria*, var. *senilis*, *Productus cora*, *P. latissimus*, *P. scabriculus*, and *P. sinuatus*, *Euomphalus*, *Naticopsis*, and *Platyceras*. The Trilobite, *Griffithides mesotuberculatus*, is abundant, but in detached parts, perfect

specimens being rarely obtained. The overlying bed of sandstone contains the impressions of *Cauda-galli*.

**CUNNINGHAM BEDLAND, 2 miles N.W. of Dalry. Lower Limestone Series.**

The upper Broadstone limestone in quarry section, containing the usual fossils. This limestone decomposes rapidly, and many corals, spicules of sponges, Producti with long projecting spines, and spiral shells, are easily obtained. Bands of a dark coloured limestone and intercalated shales, lower in the section, which crop out at the water's edge, contain *Aviculopecten* and *Pteronites*.

**HAWHILL, 1½ mile N.W. of Dalry. Upper Limestone Series.**

Section on Rye Water. Shale and impure limestone. *Bellerophon Urvii*, *B. Dumontii*, *Myalina Verneuli*, in shale.

**HIGHFIELD, 2 miles N.E. of Dalry. Ironstone pits. Lower Coals and Ironstones.**

*Rhizodus* and other fish remains, and plants in the shale above the clay-band ironstone.

**HIGHFIELD QUARRY, 2½ miles N.E. of Dalry. Upper Limestone Series.**

Limestone and shale. Crinoid stems and finger-joints of *Poteriocrinus* abundant in the shale heaps; also *Bairdia curta*, var. *plebeia*, *Productus longispinus*, and *P. latissimus*.

**HOWRAT, 3 miles N.W. of Dalry, near Howrat Toll Bar, on Largs Road. Lower Limestone Series.**

Limestone in quarry sections. Corals, Crinoids, Brachiopoda, and other shells, fish palates, and bones.

**LYNN SPOUT, 1 mile S.W. of Dalry. Upper Limestone Series.**

Limestone and shale. *Alveolites septosa*, *Productus scabriculus*, *Cypriocardia*, *Posidonomya*, and other bivalves; also *Estheria punctatella*, very abundant.

**REDDANS, 1½ mile W. of Dalry. Ironstone pit. Lower Coals and Ironstones.**

Teeth, scales, and spines of fishes in the ironstone and shales.

**SWINDRIDGE QUARRY, 3 miles N.E. of Dalry, near the Den. Upper Limestone Series.**

Limestone and shale. *Productus latissimus*, *Leda attenuata*, *Nucula gibbosa*, *Dentalium priscum*, *D. inornatum*, *Macrocheilus fusiformis*, *Murchisonia striatula*, *Bellerophon decussatus*, *B. Urvii*, *Gyrolepis Rankinvi*, and *Cochliodus magnus*.

**Douglas District.**

**BROCKLEY, 1½ mile N.W. of Douglas. Lower Limestone Series.**

Limestone and shale, exposed in section on the banks of the Ponnell Water. Some of the old shale heaps on the left bank, in ascending the stream, are very full of well-preserved fossils, such as *Heterophyllia*, *Stenopora*, *Favosites*, and some of the smaller corals, Crinoid heads, a large *Spirorbis* usually detached, a considerable number of Entomostraca and Foraminifera in most exquisite condition, of which *Beyrichia bituberculata* and *Kirkbya Permiana* are the most abundant, Polyzoa in fragments, but

well preserved, or incrusting shales and crinoid stems, *Terebratula hastata* and its varieties, *Athyris Royssii*, frequently covered with its fringes of delicate spines, *Spirifera trigonalis*, *S. lineata*, *S. Urii*, a few bivalves, but they are very rare, and so are also spiral shells, Cephalopoda, and the remains of fishes.

**CRAIGBURN**, a few yards above turnpike road, 2½ miles N.N.E. of Douglas. Upper Limestone Series. The Gill Limestone of the Lesmahagow District.

The principal fossils found in this shale are *Valvulina plicata*, *Palæocyryne*, *Heterophyllia*, *Ortonia carbonaria*, *Griffithides mucronata*, *Vincularia approximata* (?), *Athyris ambigua*, *Rhynchonella pleurodon*, *R. pugnus*, and *Strophomena distorta*. There appear to be few lamellibranch bivalves and spirals.

**KENNOX WATER**, about ½ mile above Kennox Water, about 4 miles S. by W. of Douglas. Upper Limestone Series, Gill Limestone.

*Amplexus coralloides*, *Cyclophyllum Bowerbankii*, and other Corals, Polyzoa, and Brachiopoda.

**WILDSHAW LIMESTONE QUARRY**, 5 miles S.E. of Douglas. Lower Limestone Series.

Few fossils are recorded from this locality; a few Brachiopoda occur, and *Stigmaria stellata*<sup>1</sup> in a siliceous sandstone.

#### Dumbarton.

**AUCHENREACH GLEN**, N.E. of Dumbarton. Ballagan Limestone Series.

Fish scales and plant remains in a gray flaggy sandstone at the head of the glen, in the north-western branch of the burn.

#### Dunlop District.

**GABROCHILL**, 2½ miles S.E. of Dunlop. Lower Limestone Series.

Limestone and shale in quarry section. Brachiopoda have been found in the limestone, but as the quarry has only been recently opened, little opportunity has been afforded for research.

**GAMESHILL**, 1½ mile S.E. of Dunlop. Lower Limestone Series.

Limestone and shale of the Beith section exposed in quarry. Corals, Crinoids, *Productus giganteus*, *P. spinulosus*, and *Spirifera trigonalis*, the latter very abundant in the shale, as well as fish palates.

**OLD MILL**, 1½ mile N.W. of Waterland Station.

Same strata as at Trearne, Beith. Quarry recently opened.

**WATERLAND**. Lower Limestone Series.

Quarry section of limestone and shale, containing Corals, Crinoids, Brachiopoda, spiral shells, and fish palates.

#### East Kilbride District.

**BLACK CRAIG**, beneath Calder Glen Farmhouse, 1½ mile E. of East Kilbride.

Black shale containing *Lingula squamiformis*, and fragmentary fish remains.

<sup>1</sup> Thomson, *Trans. Geol. Soc. Glasgow*, vol. iv. p. 96.

**BRAEHEAD QUARRY**,  $\frac{1}{2}$  mile N. of Eaglesham Road Station. Main Limestone Series.

Thick-bedded limestones and shales. The limestone is not very fossiliferous; it contains, however, *Lithodendron junceum*, *Alveolites septosa*, and a few species of Brachiopoda. Some of the shales contain fish bones, scales, and teeth, and one bed is almost entirely made up of the crushed valves of a small Entomostracan, with scattered fish scales and coprolites.

**BRANKAMHALL QUARRY**, 1 mile N.E. of East Kilbride.

Limestone and shale. Lower fossiliferous shale bed, containing the same fossils as at Newfield and Broomhouse. This locality is the Laurieston of Ure, and one of the localities from which he got his Kilbride fossils.

**CALDER WATER**, opposite Old Calderwood Mines,  $1\frac{1}{2}$  mile E. of East Kilbride.

Exposure of both of the Calderwood limestones and shales, with usual fossils.

**CALDER WATER**, Bridge from Basket Farm to Tower on Calderwood Grounds, on right bank above footpath, 2 miles N.E. of East Kilbride.

Shale overlying thin band of limestone in Crossbasket ironstone series, contains *Sphenopteris crassa*, *Serpulites carbonarius*, *Productus semireticulatus*, *Aviculopecten papyraceus*, *Pteronites persulcatus*, and *Modiola subparallela*.

**CAPELEIG QUARRY**, 1 mile N.E. of East Kilbride.

Limestone and shale. Lower shale bed with same fossils as at the adjoining quarry of Brankamhall. The upper black shale bed is also present, containing its peculiar group of organisms, and the bored limestone pebbles.

**CRAIGHALL QUARRY**, near South Craighall Farmhouse, 3 miles S.W. of East Kilbride. Lower Limestone Series.

Main limestone well exposed at this locality, from which the following fossils have been collected: *Cyathophyllum fungites*, *Orthis Michelini*, *O. resupinata*, *Productus costatus*, *P. giganteus*, *P. spinulosus*, *P. Youngianus*, and *Petalodus Hastingsia*.

**CROSSHOUSE FARM**,  $2\frac{1}{2}$  miles S.W. of East Kilbride. Lower Limestone Series.

Old quarry, with main limestone exposed in small section. The fossils, especially the Brachiopoda, are much the same as at Craighall, but the following in addition are recorded: *Amplexus spinosus*, *Zaphrentis Phillipsi*, *Archæocidaris Urii*, *Poteriocrinus crassus*, *Diastopora megastoma*, *Vincularia approximata* (?), *Athyris Roysii*, *Chonetes polita*, *Productus latissimus*, *P. punctatus*, *Rhynchonella pleurodon*, *Spirifera lineata*, *Streptorhynchus crenistria*, *Terebratulula hastata*, and *Petalodus* (?) *lobatus*.

**EAST DRUMLOCH FARMHOUSE**, 3 miles S.E. of East Kilbride.

Quarry section of Calderwood limestone with *Palæocoryne Scoticum*, *Sulcoretepora parallela*, *Vincularia approximata* (?), *Productus giganteus*. In the shale immediately overlying are Corals and Brachiopoda.

**GILL BURN**,  $\frac{3}{4}$  miles W.S.W. of East Kilbride.

Calderwood cement limestone exposed in the bed of the burn, but few fossils collected from it.

**GLEBE QUARRY, near East Kilbride Kirk.**

Calderwood cement limestone. The following are among the more important fossils collected recently, chiefly by Mr. A. Paton: *Adiantes Lindseiformis*, *Odontopteris lingulata*, *Sphenopteris affinis*, *S. bifida*, *S. obovata*, *Volkmannia Morrisii*, *Trigonocarpum Gloagianum*, *Dithyrocaris glabra*, *D. granulata*, *D. ovalis*, *D. testudineus*, *Orthoceras cinctum*, and *Gyracanthus tuberculatus*.

**HAIRMYRES. Station on East Kilbride Railway. Lower Limestone Series.**

There is hardly any section visible at the old workings from which Ure doubtless collected his fossils upwards of eighty years ago, as they are filled up with water, and the shale heaps are grass-grown. Near the station between the railway and the curling-pond the shale is found *in situ*, and the following are some of the species obtained from the washings: *Endothyra Bormanni*, *E. globulus*, *Valvulina palæotrochus*, and other species of Foraminifera, *Spirorbis spinosa*, *Ortonia carbonaria*, several species of Ostracoda and Crinoids, and about twenty-six species of Polyzoa.

The weathered fissures of the limestone in a small quarry opening a little to the westward are prolific in spiral univalves and other shells, and many of the *Naticopsis* and *Pleurotomaria* have their aperture entire. Most of the specimens are found in relief, many of them being but slightly attached to the rock, while nearly all possess their original sculpturing in a wonderful state of preservation.

**KIRKTONHOLM CEMENT WORKS at East Kilbride Railway Station.**

Calderwood cement limestone and shale. Limestone wrought in mines. Same fossils as at the Glebe Quarry. In addition to those noted from that locality we have to record—*Dithyrocaris tricornis*, *Spiriferina insculpta*, *Trochus lepidus*, *Cyrtoceras rugosum*, *Nautilus nodiferus*, *Goniatites crenistria*, *Rhizodus Portlockii*, *Psammodus porosus*, *Cochliodus contortus*, *Gyrolepis Rankinii*, and *Oracanthus minor*. These are some of the rarer forms.

**LICKPRIVICK, 2 miles S.W. of East Kilbride.**

Calderwood cement limestone and shale—hardly any section visible. The following are among the fossils collected from the old shale heaps:—*Productus longispinus*, coarse-ribbed variety, abundant, other Brachiopoda rare; *Nucula gibbosa* and *Leda attenuata* common as casts; pyritized pieces of plants common, and sometimes well marked. Mr. James Bennie found here a test of *Dithyrocaris* with teeth *in situ*. (See *Geol. Mag.* vol. ii. pl. xi. fig. 6.) Bored pebbles are found in great abundance and perfection; they often occur as nodules containing coprolitic matter, but in every case they were pebbles, or in that condition, when bored. There are many nodules proper or native to the shale, but of course they are never bored.

**LIMEKILNS. Old Limestone Quarry near Limekilns House, East Kilbride.**

The lower part of the section is obscured by *débris*, but from a few small shale heaps fossils corresponding with those of the lower shale bed of Capelrig and Newfield have been found; *Beyrichia multiloba* and one or two species of *Cythere* have been obtained in the shale washings, as well as *Kirkbya Urie*, which was originally derived by Ure from this locality.

**LONGLANDS HOUSE, 2½ miles S. of East Kilbride.**

Calderwood cement limestone and shale. Shale *in situ* beneath the *débris* of old ironstone quarry on right bank of Calder Water, also good exposure of section on same side near house.

SHIELDBURN, near Benthall, 2½ miles S. of East Kilbride.

Casts of Brachiopoda and other shells in ash bed below the main limestone.

SOUTH SHIELLS, 2 miles S.W. of East Kilbride. Lower Limestone Series.

Limestone and shale in quarry section. Corals, *Productus giganteus* and other Brachiopods, *Polyrhizodus radicans*, *Helodus mammillaris*, and sundry other palates. *Trigonocarpum* have been found in a soft blue shale between the encrinal and the coralline limestone, and pieces of carbonized wood are common both to the shale and limestones.

THORNTON QUARRIES, near Eaglesham Road Station, East Kilbride Railway.<sup>1</sup> Main Limestone Series.

The section here is, with some slight variations, the same as at Braehead, that at Thornton old, or No. 1 Quarry, being, however, the most typical. The following is the succession of beds, which are capped by about 12 feet of boulder-clay:—Limestone; black shale with oolitic nodules, and *Athyris*, *Spirifera*, and *Orthis*; limestone; soft black shale, lower half fire-clay, with *Stigmara* roots; ash bed, with layers of impure limestone or ironstone, the "bandstone" of the quarry, also with *Stigmara* roots; gray shale; shale with square-edged oblong nodules, coprolites and reptilian bones; black bituminous shale with fish scales; green shale with encrinal remains, crushed *Spirifera*, and fish scales; ironstone; fire-clay; ironstone; Entomostracan oil-shale; black shale and fire-clay; impure limestone; shale about 2 inches, with palatal teeth; limestone, with partings of shale; soft black shale; volcanic ash-bed, full of large pebbles. The whole section is full of geological interest, from the indications which it affords of old land surfaces, lake and marine conditions, and of volcanic action evidenced by the ash-conglomerates.

#### Fauldhouse District.

CLIMPY, 3 miles from Fauldhouse Station.

Several old lime workings. Palatal teeth, *Orthoceras*, *Spirifera*, *Retzia*, *Productus*, *Nucula*, *Cypricardia acuticarinata*, and *Conularia* may be collected from the shale heaps.

CROFTHEAD, near Fauldhouse Station.

Coal and ironstone pits. *Ctenacanthus*, *Megalichthys*, *Pleurodus*, and other species of fishes; also *Pecopteris*, *Neuropteris*, and *Calamites*.

LEVENSEAT, 1 mile from Fauldhouse Station.

Limestone, with a few species of Corals and shells, but fossils are not abundant. *Gyrolepis Rankinii* and some fish remains occur in a bed of oil shale.

#### Garnkirk.

Limestone pits and mines. Upper Limestone Series.

Limestone, with *Productus*, *Spirifera*, *Athyris*, *Nautilus*, and *Orthoceras*. The same beds are worked at Moodiesburn and Bedlay.

GLENBOIG FIRE-CLAY QUARRY, 2 miles E. of Garnkirk. Upper Limestone Series.

Cement limestone. Little is known about the fossils of these beds;

<sup>1</sup> *Trans. Geol. Soc. Glasgow*, vol. iv. p. 282. James Neilson, jun., "On some Sections of Carboniferous Limestone near Busby."



there is a layer of *Streptorhynchus crenistria*, however, about a foot in thickness, but few are extractable, and none are good.

#### Govan.

Ironstone pits. Lower Coals and Ironstones.

*Murchisonia striatula*, *Azinus orbicularis*, *Aviculopecten*, *Lingula squamiformis*, and other marine shells in the shales above the Govan ironstone.

#### Hamilton District.

AVON, BANKS OF THE, near Hamilton. Upper Coal Measures.

Shales in the first precipitous cliff, left bank of the Avon, above the bridge. *Neuropteris gigantea*, *N. Loshii*, *Sphenopteris Hibbertii*, *Lepidodendron obovatum*, and *Calamites*.

BOGHEAD, 2 miles W. of Quarter Road Station. Calderwood limestones and shales.

Old limestone quarries on the farms of Boghead, Craigendhill, and Burnhead. Calderwood cement stone with *Aviculopecten* and *Posidonomya corrugata*; black shale with *Spirifera Uriei* and *Goniattites Looneyi*; a thick bed, in some places 8 feet, of soft earthy shale, very rich in fossils. Some of the more characteristic are:—*Orthoceras undatum* and *O. laeve* (the *O. superfcie sulcata* and the *O. superfcie levi* of Ure), *Bellerophon Duchastellii*, *Pleurotomaria Yvanii*, *Leptodomus costellatus*, *Pecten Sowerbii*, *Discina nitida*, with colour markings, *Crania quadrata*, *Lingula mytiloides*, *Chonetes Laguessiana*, *Diastopora megastoma*, *Ceripora interporosa*, *Stenopora tumida*, *Pisocrinus globularis*, and the cup plates of several other species of crinoids. The black shale contains limestone pebbles, which appear to have been bored either by an annelid or a gasteropod, probably by the latter. All the holes are cup-shaped, and vary in size from a pin point to  $\frac{1}{4}$ th of an inch in diameter. Sometimes only two or three holes are visible on a stone, while others are literally covered with them. These pebbles are found in the same shale, though rarely, in the Newfield, Broomhouse, and Auchintibber section, but at all the other localities they are common, and can be found in abundance if sought for. The earthy shale varies much in its fossils. At Burnhead Farm Crinoids are few, while shells are very numerous and in good preservation; at Craigendhill the shale is often very barren, except in that taken out of the day-level mine, under the farmhouse, which is full of fossils, identical with those of Newfield; at Boghead Farm there are scarcely any at all in some parts of the shale; in other parts they occur in immense numbers. The reason of these differences is not very obvious, but probably the organisms lay in patches and not in regular beds, over the old sea bottom.

BROWNTON, near Limekilnburn Toll-bar, 3 miles S. of Hamilton. Upper Limestone Series.

Limestone and shale. The shale fossils consist chiefly of *Palaeacis cyclostoma*, and small cup corals, Crinoids, Polyzoa, *Spiriferina*, *Strophomena rhomboidalis*, var. *distorta*, *Retzia radialis*, *Orthis resupinata*, *Productus longispinus*, *Discina nitida*, *Lingula mytiloides*, *Nucula gibbosa*, *Leda*, *Azinus*, *Aviculopecten simplex*, *Platyceras vetustus*, *Bellerophon Uriei*, *Conularia quadrisulcata*, *Pleurotomaria*, *Nautili*, and small *Orthoceratites*. The fossils here and at Limekilnburn are specifically identical with those of Gare, near Carlisle.

FERNIGAIRE, 1 mile N.E. of Hamilton. Coal pits. Upper Coal Measures.

*Lepidodendron obovatum* and other plants in the roof of the main coal; *Sigillaria oculata*, *S. nodosa*, and *Calamites* in the floor of the splint coal; and *Neuropteris*, *Alethopteris*, *Asterophyllites*, and several other species of plants in a reddish coloured shale above the splint coal.

LIMEKILNBURN TOLL BAR, 1 mile W. of Quarter Road Station. Upper Limestone Series.

Old shale heaps, containing the same fossils as at Brownlod. Fish palates of several species have been found here. The encrinites in the shale are often split and water worn, and they frequently bear the parasitical coral *Paleacis cyclostoma*.

QUARTER, 1 mile from Quarter Road Station. Ironstone pits. Upper Coal Measures.

*Megalichthys rugosus*, *Anthracosaurus Russellii*, *Loxomma*, *Pteroplax*, *Megalerpeton*, and *Pholaderpeton* in a bed of coaly shale, between a thin seam of coal and the overlying ironstone.

#### Howood.

HOWOOD, 1 mile W. of Milliken Park Station. Lower Limestone Series.

Limestone and shale. Brachiopoda, Corals, crushed heads of *Potriocrinus M'Coyanus*, not uncommon, as well as Crinoid remains generally.

#### Jordanhill.

JORDANHILL, 2½ miles W. of Glasgow. Ironstone pits, Possil and Govan series. Lower Coals and Ironstones.

Fish remains in some of the blackbands, *Lingula* and *Myalina* in the shales.

KNIGHTSWOOD, 2½ miles W. of Glasgow. Ironstone pits. Lower Coals and Ironstones. Same fossils as at Jordanhill.

SKATERIGG, 2½ miles W. of Glasgow. Lower Coals and Ironstones.

Same beds as at Jordanhill and Knightswood.

#### Kilmarnock District.

CRAIGIE, 3 miles S. of Kilmarnock. Lower Limestone Series.

Quarry section. Limestone with Corals and *Productus giganteus*; ironstone balls overlying limestone contain *Rhynchonella pleurodon* in abundance, and *Spirifer trigonalis*; shale above contains *Porcellia armata*, *Ostracoda*, and corals; upper band of limestone with *Athyris ambigua* in thousands, along with two species of *Vincularia*.

PLAN, 2½ miles W. of Kilmaurs. Ironstone pits. Upper Coal Measures.

Plants, *Anthracosia* and fish remains in ironstone and shales.

WOODHILL QUARRY, 2 miles W. of Kilmarnock. Sandstone quarry. Upper Coal Measures.

Ironstone nodules in shale above the sandstone contain *Pecopteris abbreviata* and other ferns; also two remarkable species of Myriapods and some limuloid crustaceans, none of which appear to have been discovered elsewhere in the Scottish coal formation.

**Kilpatrick District.****AUCHENTORLIE GLEN, Bowling. Calciferous Sandstone Series.**

Beds of impure coal and carbonized wood showing structure, indurated shales containing coprolites, scales and teeth of ganoid fishes, are found interbedded between the sheets of trap in this glen, and at other points in the Bowling range.

**DUNTOCHER. Lower Limestone Series.**

The Campsie main limestone, wrought in pits, but as yet not very productive in fossils. The underlying shale contains the large scales of *Rhizodus Portlockii* and *Leptodomus costellatus*. A section of shale at an old limestone quarry at Faifley contains Crinoids, Brachiopoda, and *Cochliodus*.

**Kilbirnie District.****AUCHENCLOICH, 2½ miles W. of Kilbirnie. Lower Limestone Series.**

Limestones and shale in natural section. Corals, Crinoids, Brachiopoda, and spiral shells.

**COLDGREEN GLEN, 3 miles S.W. of Kilbirnie. Lower Limestone Series.**

Section of limestone and shale on the Puddock Burn. Corals and Brachiopoda.

**CRAWFIELD, 1 mile S.E. of Kilbirnie Station. Lower Limestone Series.**

Lower beds of Beith section. Not very fossiliferous. A few *Producti* and *Spirifera* are common; Crinoid stems, Corals, and palatal teeth occur, but being mostly in hard limestone, are with difficulty extracted from the matrix.

**PUDDOCK BURN, 2 miles W. of Kilbirnie. Lower Limestone Series.**

Sections of sandstones, shales, and ironstones, from Kilbirnie to Dykes Farmhouse, and from thence to near the source of the stream, there are several sections of limestones and shales, which contain the usual fossils of the Beith limestones.

**Kilwinning District.****CARTLEBURN, 1½ mile N. of Kilwinning. Lower Limestone Series.**

Limited quarry section of the upper Broadstone limestone, very full of Brachiopoda.

**CLONBEITH, 3 miles N.E. of Kilwinning Station. Upper Limestone Series.**

Shale heaps in old quarry. *Nucula*, *Leda*, *Bellerophon*, Entomostraca.

**DEBNSHAW, 5 miles N.E. of Kilwinning Station. Upper Limestone Series.**

Old quarry. *Orthoceras*, *Azinus*, *Pleurotomaria*, and Brachiopoda in the shale.

**FERGUSHILL PITTS, 2 miles N.E. of Kilwinning Station. Upper Coal Measures.**

*Megalichthys*, *Rhizodopsis*, *Diplodus*, *Gyracanthus*, *Pleurodus*, and other fish remains in oil shale.

**GOLDORAIG QUARRIES, 2 miles E. of Kilwinning. Upper Limestone Series.**

Limestone and shale. *Streptorhynchus crenistria* very common, Crinoid stems and finger-joints are abundant in the shale. The limestone is now

mined, so that the locality is not so good a field for collectors as it used to be, but some of the shale heaps still yield a few fossils to an experienced searcher.

**LUGTON WATER**, below Seven-Acres Mill, 2 miles N. by E. of Kilwinning Station. Upper Coal Measures in river section.

*Megalichthys*, *Pleurodus*, &c., in bituminous shale.

**LYLESTONE QUARRY**, 3½ miles E. of Kilwinning. Upper Limestone Series.

Limestone and shale. Crinoid remains, Brachiopoda, bivalves and spiral univalves. The old shale heaps are becoming grass-grown, but will still repay a visit.

**MAVISBANK**, 4 miles N.E. of Kilwinning Station. Upper Limestones.

Old quarry. Crinoids, Ostracoda, &c., in shale.

**MONTCASTLE GLEN**, 2½ miles N. by W. of Kilwinning Station. Upper Limestone Series.

Sections of sandstone, limestone, and shales. Trilobites and the other Bowertrapping fossils in the limestone, *Macrocheilus*, *Loxonema*, *Arca Cypricardia*, &c., in the shale.

**MONTCUR PITS**, 1½ mile E. of Kilwinning Station. Upper Coal Measures.

*Megalichthys*, Ostracoda, *Spirorbis*, &c., in shale and ironstone balls.

#### Kilsyth District.

**BANTON**, near Kilsyth. Upper Limestone Series.

Limestone, containing Brachiopoda and large *Nautili*.

**CORRIEBURN**,<sup>1</sup> 3 miles N.E. of Kirkintilloch. Lower Limestone Series.

Limestone, shale, ironstone, and sandstone. The principal fossils of Corrieburn are corals, one of which, *Lithodendron fasciculatum*, forms a distinct band, several species of Polyzoa, including the rare *Ptylopora pluma*, *Productus Youngianus*, *Aviculopecten fimbriatus*, *A. granosus*, *Pteronites persulcatus*, *Conocardium aliforme*, a bed of *Myalina crassa*, and a few fish palates. A number of finely-preserved Brachiopoda have been found in the white shale overlying the coralline limestone. The superior attractions of Corrieburn are, however, its illustrations of physical geology, as seen in the uptilted sedimentary strata, interbedded traps, and volcanic ashes, the effects of the igneous forces on some of the sandstones and limestones, the evidences of ice-action in the great deposit of boulder-clay, containing large striated boulders, and its lofty scour of clay ironstone and shale which rises from the eastern burn.

**KILSYTH**. Ironstone pits. Lower Coals and Ironstones.

Plant remains in the sandstones, and fossils in the ironstones and shales similar to those of the Possil and Govan blackband ironstones.

#### Larkhall.

**WOODSIDE COAL PITS**, 2 miles S.E. of Larkhall. Upper Coal Measures.

*Calamites nodosus*, *Pecopteris laciniata*, *Sphenopteris excelsa*, *S. polyphylla*,

<sup>1</sup> See Mr. John Young's paper, published in vol. i. of the *Transactions*, for a description of Corrieburn and the other fossil-bearing strata of the Campsie district.

and *Sphenophyllum Schlotheimii*, in shales above the splint coal; *Anthrocoptera* and allied shells.

### Lesmahagow District.

#### AUCHINBEG QUARRY, 3 miles S. of Lesmahagow. Upper Limestone Series.

Limestone and shale. The limestone contains Brachiopoda, *Nautili*, fish palates, &c.; the shale contains *Productus*, *Athyris*, and *Lingula*, and bivalve shells of the genera *Azinus*, *Cardiomorpha*, *Leda*, *Nucula*, *Arca*, *Mytilus*, *Myalina*, *Sanguinolites*, and *Solenopsis*; one or two small *Goniatites*, and the carapace of *Dithyrocaris tenuistriatus*. Besides the shale-heaps in the quarry there are others at the old workings close adjoining.

#### AUCHINHEATH, 3 miles N. of Lesmahagow. Gas coal and ironstone pits. Middle Coals and Ironstones.

*Palæoniscus*, *Megalichthys*, Plants and Ostracoda in the blackband ironstone, *Lepidodendron*, *Calamites*, *Myalina*, and scales of fishes in the shale above the overlying gas coal.

#### AUCHMEDEN QUARRY, 2½ miles E. of Lesmahagow. Lower Limestone Series.

Limestone and shale. Corals, Crinoids, and Brachiopoda.

#### AUCHREN QUARRY, 1½ mile E. of Lesmahagow. Lower Limestone Series.

Limestone and shale. Brachiopoda, Corals, and Crinoids.

#### BIRKWOOD BURN, 1½ mile N. by W. of Lesmahagow. Lower Limestone Series.

Limestone and shale. *Lonsdaleia duplicata*, *Poteriocrinus crassus*, and a few species of Brachiopoda have been reported from this section.

#### BIRKWOOD QUARRY, 2 miles N. of Lesmahagow. Lower Limestone Series.

Limestone and shale. Brachiopoda and Crinoids.

#### BOGHREAD QUARRY, 3 miles N.W. of Lesmahagow. Lower Limestone Series.

Limestone and shale. *Alveolites depressa*, *Fistulipora minor*, *Lithostroton decipiens*, and many other rare corals, some of which, such as *Lonsdaleia rugosa* and *Syringopora reticulata*, are found in great masses branching throughout the limestone, which also contains a number of species of *Aviculopecten* and *Nautilus*.

#### DEN, 3 miles N. of Lesmahagow. Lower Limestone Series.

Limestone and shale, in quarry section, containing Corals and Brachiopoda.

#### HALL HILL, 3¼ miles N.E. of Lesmahagow. Lower Coals and Ironstones.

*Lingula Scotica*, in an ironstone shale 15 feet above the gas coal.

#### HILL, 1 mile S. of Lesmahagow. Lower Limestone Series.

Old limestone quarry. Crinoid remains in the shale heaps.

#### KERSH GILL, 1½ mile N. of Lesmahagow. Lower Limestone Series.

Limestone and shale in quarry section, very fossiliferous. Brachiopoda and Corals.

#### MIDDLEHOLM, near Stockbriggs, 2 miles S.W. of Lesmahagow. Lower Limestone Series.

Limestone and shale, with Brachiopoda and Crinoids.

**TEIGLAM BURN**, 1 mile N. by W. of Leasmahagow. Lower Limestone Series.  
Limestone and shale, very full of fossils. Brachiopoda, Aviculopectens, and spiral univalves.

**Lochwinnoch.**

**NETHERHOUSES**, 1 mile S. of Lochwinnoch. Lower Limestone Series.

Limestone in quarry section, containing Corals, Crinoids, and Brachiopoda, but not well preserved; good specimens are rare.

**Lugar District.**

**BELLO WATER**, 1 mile E. of Lugar Station. Upper Coal Measures.

*Anthracosia robusta* form a bed 18 inches in thickness.

**CUB'S GLEN**, 1 mile S.E. of Lugar Station. Upper Limestone Series.

Section of indurated shale, limestone, and trap. Fossils not in good keeping. *Streptorhynchus crenistria*, *Orthis resupinata*, *Nucula gibbosa*, *Leda attenuata*, *Conularia quadrisulcata*. Portions of the shale and limestone are enveloped in the trap.

**GAS WATER**, 3 miles E. of Lugar Station. Lower Limestone Series.

Limestone and shale in quarry section. The upper bed of hard shale is filled with *Productus giganteus* lying in their natural position, with the ventral valve downwards. Other fossils appear to be very rare.

**GLENMUIR QUARRY**, 3 miles S.E. of Lugar Station. Lower Limestone Series.

The same section as at Gas Water with the characteristic *Productus*.

**GLENMUIR WATER**, 5 miles S.E. of Lugar Station. Lower Coals and Ironstones.

Bed of shale containing two species of *Sphenopteris* in great profusion.

**GWELT WATER**, 5 miles S.E. of Lugar Station. Lower Limestone Series.

Section of limestone and shale with *Productus giganteus*, *P. muricatus*, *P. latissimus*, *Orthis resupinata*, *Myacites sulcata*, and erect crinoid stems.

**LUGAR**. Coal and Ironstone pits. Upper Coal Measures.

*Anthracosia*, *Calamites*, and ferns.

**Mount Vernon.**

**UPPER COAL MEASURES.**

The Kiltongue coal is wrought at this locality close to the railway-station, and specimens of *Pecopteris*, *Sphenopteris*, and *Trigonocarpum* may be collected from the roof shale and the impure ironstone bands.

**Muirkirk District.**

**AULDBOUSE BURN**. Lower Limestone Series.

*Productus giganteus*, *Alveolites septosa*.

**CROSSFLAT**. Lower Limestone Series.

**GLENBUCK**. Lower Limestone Series.

**GARPEL WATER**.

Both the Upper and Lower Limestone Series are exposed in the course

of this stream, the former about 100 yards above the railway bridge, where Polyzoa are abundant in the shale, which also contains Crinoid heads, *Trilobites*, *Spiriferina insculpta*, *Strophomena distorta*, and a number of other forms. The limestone and shale of the lower series are exposed in quarry section about a mile and a half above the railway-bridge, and also to the east along the face of Cairn Table, where *Productus giganteus*, *Spirifera*, *Terebratula*, and Corals may be collected in abundance.

#### Newton.

STATION ON CALEDONIAN RAILWAY, South-side Branch. Coal pits. Upper Coal Measures.

Mussel-band contains *Anthracosia Urti*, *Spirorbis helicteres*, and *S. carbonarius*. The roof-shale of the splint coal has yielded *Orthacanthus cylindricus*, *Diplodus gibbosus*, *Ctenacanthus brevis*, and *C. major*.

#### Paisley.

INKERMAN,  $1\frac{1}{2}$  mile W. of Paisley. Ironstone pits. Lower Coals and Ironstones.

*Bellerophon Dumontii*, *B. Urti*, *Pleurotomaria*, *Dentalium*, *Myacites sulcata*, *Edmondia*, *Pinna spatula*, *Athyris*, *Productus*, and several other marine shells in a bed of gray shale overlying the Govan ironstone, also, in one instance only, *Pygocephalus Huxleyi* in a clay ironstone nodule from one of the shales. *Lingula squamiformis* is very abundant in a semi-bituminous shale.

#### Fossil District.

COAL AND IRONSTONE PITS. Lower Coals and Ironstones.

Large teeth and jaws of *Rhizodus* in blackband ironstone and adherent coaly shale, also *Lingula squamiformis* of large size; several species of *Palaeoniscus*, *Acanthodes sulcatus*, *Gyrolepis* and *Lepidodendroid* plants in the ironstone and bituminous shale.

PROVANHALL, 3 miles N.E. of Glasgow. Coal pits near the Monkland Canal. Upper Coal Measures.

Fish remains, Entomostraca and crushed *Anthracosia*, abundant in a thin band of bituminous shale; plant remains in other shales.

#### Robroyston.

OLD LIMESTONE QUARRIES AND IRONSTONE PIT, 1 mile N. of Broomfield Bridge, Caledonian Railway, Garngad Road. Upper Limestone Series, and Lower Coals and Ironstones.<sup>1</sup>

The fossils quoted from this locality have been obtained from three different sources:—1st, From old shale heaps near the farm of Barmulloch; 2d, from old shale heaps  $\frac{1}{2}$  mile N.E. near Hillhead Farm; and 3d, from shale at an ironstone pit close by the latter locality, in the spring of 1863. At the first of these two places the larger number of the typical fossils are specifically, and, as regards their state of preservation, identical with, those of the Gare beds:—Foraminifera, four species, *Zaphrentis Phillipsi*, *Poteriocrinus*, *Vermilia minuta*, thirteen species of Ostracoda, *Griphulides mesotuberculatus*, *Diastopora megastoma*, *Chonetes Laguessiana*, *Crania quadrata*, *Discina nitida*, *Lingula mytiloides*, *Orthis resupinata*, *Productus longi-*

<sup>1</sup> Vide Messrs. Young and Armstrong's account of the Robroyston beds and list of Fossils, *Trans. Geol. Soc. of Glasgow*, vol. iv. p. 267.

*spinus*, *P. semireticulatus*, *Rhynchonella pugnus*, *Streptorhynchus crenistria*, *Cypriocardia crebricostata*, *Leda attenuata*, *Nucula gibbosa*, *N. lineata*, *Conularia quadrisulcata*, *Chiton humilis*, *Loxonema scalarioidea*, *Macrocheilus Michotianus*, *Murchisonia striatula*, *Pleurotomaria Benediana*, *P. contraria*, *P. monilifera*, *P. striata*, *Naticopsis Robroytonensis*, *Bellerophon Urii*, *B. decussatus* and var., *B. Leveilleanus*, *Cyrtoceras Gesneri*, *C. unguis*, *Goniatites paucilobus*, *G. striolatus*, *Nautilus nodiferus*, and *N. quadratus*. The shale brought up during the sinking of the pit to the Possil ironstone was passed through about 500 feet from the surface. It contained two species of *Lingula* in their natural vertical position, *Goniatites*, two species of *Cardiomorpha*, *Leda*, *Nucula luciniformis*, *Solenopsis minor*, and the carapace of *Dithyrocaris tenuistriatus*. The same shale has been found eastwards of Bishopbriggs, in sinking pits to the Possil blackband ironstone.

There are a number of old shale heaps a little to the east of Robroyton mansion-house, from which the same fossils may be had, especially the crinoids, as at the first two places mentioned above.

#### Rutherglen.

##### COAL PITS. Upper Coal Measures.

*Gyracanthus formosus* in roof of splint coal; *Sphenophyllum erosum*, *Pinularia capillacea*, *Sphenopteris latifolia*, *Asterophyllites grandis*, *Cyclopteris dilatata*, *Lepidodendron selaginoides*, *Neuropteris*, &c., in an overlying light-coloured gray shale. These plants and several other species were obtained plentifully during the sinking of the Shawfield pit a few years ago.

#### Shettleston.

##### COAL PITS. Upper Coal Measures.

Fish spines in roof shale of the splint coal, associated with *Anthracosia*, *Anthracomya*, and *Anthracoptera*.

#### Shotts District.

##### BENHAR, 3 miles E. of Shotts Kirk. Upper Limestone Series.

Slaty-band ironstone. Fish remains, marine shells, and Crustaceans.

##### CLELAND, 4 miles S.W. of Shotts Kirk. Coal pits. Upper Coal Measures.

Fish remains, *Anthracosia* and *Anthracoptera* in the roof of the splint coal.

##### DRUMBOWIE, 1 mile W. of Shotts Kirk. Ironstone pits. Upper Limestone Series.

Slaty-band ironstone. Same beds as at Benhar and Goodhock Hill.

##### GOODHOCK HILL, 1 mile W. of Shotts Kirk. Ironstone pits. Upper Coal Measures.

*Celacanthus lepturus*, &c., *Anthrapalaemon Grossartii*, and marine shells in the slaty-band ironstone.

##### GREENHILL, 2 miles S.W. of Shotts Kirk. Upper Coal Measures.

Fish-remains, *Anthracosia*, *Anthracoptera*, and Entomostraca, in shales of the Virtue Well coal, and Kiltongue mussel-band.

##### HARESHAW, 2 miles S.W. of Shotts Kirk. Ironstone pits. Upper Coal Measures.

Fish remains, *Anthracosia*, *Anthracoptera*, and Entomostraca, in the Kiltongue mussel-band.



**JERVISTON, 1½ mile S. of Holytown. Coal pits. Upper Coal Measures.**

*Pleurodus*, *Pleuracanthus*, and *Gyracanthus* in the roof shale of the splint coal.

**SHORTS IRONWORKS. Coal pit. Upper Coal Measures.**

The Drumgray coal is wrought at this locality under the name of the "Furnace Coal." Palatal teeth are very abundant in the roof shale, which also contains a species of *Mesolepis*.

**Sorn.****Four miles E. of Mauchline Station. Upper Limestone Series.**

Limestone and shale. *Petalodus*, *Productus latissimus*, *P. longispinus*, *Chonetes Lagunesiana*, *Bellerophon Urii*, *Lithodendron fasciculatum*, and *L. junceum*.

**Stevenston.****HALLERHIRST, near Stevenston. Lower Limestone Series.**

Old quarry section. Fossils are tolerably abundant among the shale heaps, but it is their condition especially which gives them a scientific interest. With the exception of the Brachiopoda, the majority of which are worn-looking and cracked, nearly all the shells exist as casts, many of them appearing to have been rolled as beach pebbles after they became fossils. The more common forms are—*Archæocidaris Urii*, plates only, crinoid stems, *Griffithides Eichwaldi*, *Athyris ambigua*, with the spires silicified, *Rhynchonella pleurodon*, *Spirifera lineata*, *Productus muricatus*, *Chonetes Hardrensis*, *Sanguinolites Edmondia*, *Cypricardia*, *Nucula gibbosa*, a *Bellerophon*, *Macrocheilus*, *Naticopsis*, and *Nautilus quadratus*.

**SANDSTONE QUARRY AND COAL PITS. Upper Coal Measures.**

Ferns are abundant in one of the roof shales; *Calamites*, *Ulodendron majus*, *Lyginodendron Landsburgii*, *Lepidodendron obovatum*, *Trigonocarpum oblongum*, and *T. ovatum*, &c., in Stevenston Quarry.

**Stewarton District.****DINNANS, 2 miles S.E. of Stewarton Station. Upper Limestone Series.**

Old Quarry. *Productus*, *Axinus*, and *Myalina* in shale.

**STACKLAWHALL, 3½ miles S.W. of Stewarton Station. Upper Limestone Series.**

Old quarry. *Archæocidaris*, and Ostracoda in shale.

**Stonehouse District.****MUIRBURN HOUSE, Section on Burn, nearly opposite, about 1½ mile S.W. of Stonehouse. Lower Limestone Series.**

Ironstone containing *Discina*, *Lingula*, *Pecten Sowerbii*, *Cypricardia rhombea*, *Leptodomus costellatus*, *Nautilus*, sp., *Orthoceras*, sp.

**SWINEHILL, 1½ mile N. by E. of Stonehouse. Upper Coal Measures.**

*Cardiocarpum tenellum* in roof of Virtue Well coal; *Megalichthys* in mussel band ironstone.

**WATSON, 1 mile S.E. of Stonehouse. Ironstone pit. Upper Coal Measures.**

*Diplodus*, *Pleurodus*, *Rhizodopsis*, and masses of shagreen-like scales in shale overlying the ironstone; *Sphenopteris crenata* in another of the shales.

**WAUKMILL, Escarpment on Avon near. Lower Limestone Series.**

Shales and ironstones overlying the second calmy limestone, containing *Lepidophyllum*, Brachiopoda, *Macrocheilus acutus*, *Bellerophon Oldhamii*, *Goniatites*, and *Orthoceras*.

**Strathavon District.****CROOKEDSTONE MUIR, about 3 miles N. of Strathavon, and 1 mile S.E. of Brownhead. Upper Limestone Series.**

Limestone quarries. *Zaphrentis Phillipsi*, *Chonetes*, *Discina*, *Lingula*, *Orthis Michelini*, *Rhynchonella pleurodon*, *Pleurotomaria*, *Bellerophon Urii*.

**GALLOWHILL,  $\frac{1}{2}$  mile E. of Strathavon. Lower Limestone Series.**

Limestone and shale on banks of the Pomillen Water and old quarry section. Corals, *Spirifera*, Polyzoa, *Griffithides Eichwaldi*, *Spirifera Urii*, *S. Carlukensis*, *Productus giganteus*, *Euomphalus carbonarius*, *Platyceras neritoides*. Fossils in tolerable abundance.

**NETHERFIELD, 1 mile E. of Strathavon. Lower Limestone Series.**

Open section on banks of the Avon, and mines. Main limestone, clay ironstone, and shale. The shale contains *Lithodendron junceum*, *L. irregularare*, *Cyclophyllum fungites*, Polyzoa of several species, *Spirifera Urii*, *S. Carlukensis* abundant, *Cypricardia rhombea*, *Euomphalus carbonarius* of large size, and *Orthoceras lineale*. Fossils abundant.

**Thornliebank District.****ARDEN QUARRY, Thornliebank. Upper Limestone Series.**

Limestone and shale. Brachiopoda belonging to the genera *Terebratula*, *Athyris*, *Spirifera*, *Rhynchonella*, and *Productus*; *Pinna flabelliformis*, *Euomphalus*, *Orthoceras*, *Nautilus ingens*, and *N. nodiferus*, *Cochliodus*, and *Psammodus*; the fossils in the shale are usually in indifferent preservation; spiral univalves and Lamellibranchiata are represented by very few species. A bed of aluminous shale underneath the limestone contains the carapace valves of *Estheria punctatella*, and small bivalve shells belonging, or closely allied to, *Naidites*, also *Modiolopsis*, and *Pteronites*.

**DARNLEY, near Darnley Toll-Bar, 1 mile S.W. of Kinnishead Station. Upper Limestone Series.**

Same limestone and fossils as at Arden. In the old quarry there are a few small shale heaps from which a few badly-preserved fossils may be had; but in the new quarry—recently opened—better opportunities for research are afforded. Üre refers to this locality as one where he had seen good specimens of *Streptorhynchus crenistria*.

**DAVIELAND, on road between Thornliebank and Eastwood Toll-bar. Upper Limestone Series.**

Same limestone as at Arden, but the shale above it is more fossiliferous. Crinoid stems are abundant in some parts, frequently wounded, and showing signs of wear before they were embedded; *Strophomena distorta* frequent, sometimes perfect, especially the young shells; *Platyceras vetustum* sometimes large; *Productus semireticulatus*, *Spirifera trigonalis*, and all the other Arden fossils. The *Estheria punctatella* shale occurs here, as at Arden, but it is seldom exposed.

ORCHARD QUARRY, 4 miles from Glasgow, on New Kilmarnock Road.  
Upper Limestone Series.

Cement limestone, with few fossils, chiefly casts. Some of the shale beds are very fossiliferous, the following being the more common:—*Poteriocrinus crassus*, *Bairdia subcylindrica*, *Cythere cuneola*, *Beyrichia bituberculata*, *B. radiata*, *Kirkbya Permiana*, *Kirkbya annectens*, teeth of *Dithyrocaris*, *Athyris ambigua*, *Lingula mytiloides*, *Productus costatus*, *Spirifera lineata*, *Streptorhynchus crenistria*, *Cypricardia acuticarinata*, *Leda attenuata*, *L. longirostris*, *Nucula luciniformis*, *Euomphalus carbonarius*, *Pleurotomaria Frenoyana*, *P. monilifera*, *P. Yvanii*, *Bellerophon Leveilleanus*, *Conularia quadrisulcata*, *Actinoceras giganteum*, *Orthoceras subcentrale*, *Tomodus convexus*, and the scales of *Rhizodopsis minor*.

WILLIAMWOOD, near Clarkston Toll. Upper Limestone Series.

Orchard limestone and shales. Not wrought at present, and old shale heaps levelled and planted. Finely-preserved specimens of *Kirkby Permiana* and *K. annectens*, the plates of a *Chiton* and *Cochliodus magnus*, were found in the shale, also encrinite stems, in excellent preservation. A little crow-toed looking organism, *Stacheia polytremoides*, was frequently found attached to the stems.

Wishaw District.

AUCHTER WATER, 3 miles E. of Wishaw. Upper Coal Measures.

Shale heap round "Curly" ironstone at David's Dykes on right bank.

NEWMAINS. Coal pits. Upper Coal Measures.

In the roof of the main coal, *Sigillaria oculata*, *S. organum*, *S. reniformis*, *Lepidodendron obovatum*, *L. Sternbergii*, *L. elegans*, *Ulodendron minus*, *Trigonocarpum ovatum*, and other plants; in the roof of the splint coal, *Gyracanthus*, *Ctenacanthus*, *Orthacanthus cylindricus*, *Ctenodus tuberculatus*, *C. imbricatus*, *Climaxodus imbricatus*, and various other fish remains; in a light-coloured shale succeeding the latter, *Sigillaria nodosa*, and in ironstone nodules, *Asterophyllites longifolia*, *Neuropteris gigantea*, *Alethopteris*, and *Calamites*.

Wilsontown District.

CLIMPY U. P. CHURCH, quarry 1½ mile W. of Wilsontown. Upper Limestone Series.

Exposure of Climpy limestone, containing *Palaeocoryne*, *Diastopora*, *Brachiopoda*, *Nucula unilateralis*.

MOUSE WATER, opposite Lambcatch, 1 mile N.N.E. Lower Limestone Series.

Kingshaw shales, with usual fossils.

MOUSE WATER, HEAD OF, 1½ mile N.E. of Wilsontown. Lower Limestone Series.

Hosie shale with Foraminifera, *Palaeocoryne*, *Poteriocrinus crassus*, and several species of *Brachiopoda*.

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## THE JURASSIC STRATA OF SKYE AND RAASAY.

### INTRODUCTION.

The fossiliferous strata of Skye and Raasay belong to the Liassic and Oolite formations. Their existence, relations to one another, and extent approximately, were first pointed out by Dr. Macculloch in his work on the Western Isles, published in 1819.<sup>1</sup> He indicated merely their broad features and made no attempt at subdivision and classification of the beds by their mineral structure or fossil contents. In 1827<sup>2</sup> Sir Roderick I. Murchison shewed, on the evidence of a few fossils discovered by Lady Murchison, that the Lower and Middle Oolite were represented by beds north of Portree harbour, and that the Lower Lias existed at Sconser on Loch Sligachan. In 1851<sup>3</sup> Professor Edward Forbes ascertained that certain strata at Loch Staffin supposed by Murchison and Sedgwick, from the examination of a few imperfect fossils found there by them, to be of the age of the Wealden, really belonged to the upper portion of the Middle Oolite. The next addition to our knowledge of the fossiliferous deposits of Skye was made in 1858 by Professor Geikie in a paper on the Geology of Strath in Skye.<sup>4</sup> He shewed on the evidence of about thirty fossil species collected by him, and named and correlated by Dr. Wright of Cheltenham, that this basin, which includes, as outliers, the Scalpa and Pabba beds, contained the Lower Lias and the lower portion of the Middle Lias. In 1869 Dr. Bryce (Glasgow) took up the inquiry where it had been left by Professor Geikie. He determined the further extent and development of the Middle Lias, the existence and development of the Upper Lias, and the relations and extent of the Oolitic beds in connection with the Lias, and in other parts of the island where the Lias does not exist. Dr. Bryce also made an examination of Raasay, of which nothing had been written later than the account given by Dr. Macculloch in his work already referred to, which is of the same vague character in regard to the Lias and Oolites, as his account of the Skye beds. From these strata and those of Skye about 300 species of fossils were collected by Dr. Bryce, and forwarded, from time to time, to Professor

<sup>1</sup> John Macculloch, M.D. *A Description of the Western Islands of Scotland, including the Isle of Man.* London, 1819. Two vols. 8vo, with plates, chiefly geological, in 4to.

<sup>2</sup> *Trans. Geol. Soc.* 2d series, pp. 293, 353.

<sup>3</sup> On the Estuary Beds and the Oxford Clay at Loch Staffin in Skye. *Quart. Journ. Geol. Soc.*, vol. vii. p. 104.

<sup>4</sup> On the Geology of Strath. Skye; by A. Geikie. With Descriptions of some Fossils from Skye; by T. Wright, M.D. *Quart. Journ. Geol. Soc.*, vol. xiv. p. 1

Ralph Tate then of Darlington, now of Adelaide University, South Australia, by whom they were named and correlated. Fifteen species were found to be new, and perfect specimens were obtained from several localities of the *Neritina Staffinensis* of Forbes, established from imperfect examples. These fifteen species are described and named in an appendix to Dr. Bryce's paper, drawn up by Mr. Tate, and given along with the general list of the species.<sup>1</sup>

### SKYE.

The south-east part of Skye consists of micaceous schists and Torridon sandstone. On this latter rock the Lias beds of the Broadford basin or valley of Strath repose, extending quite across the depressed narrow tract from Broadford Bay to Loch Slapin. This basin is bounded on the west by the vast eruptive masses of the syenite and hypersthene mountains; and the whole remaining surface of Skye is occupied by vast sheets of basaltic rocks, diorites, dolerites, amygdaloids, ash, and tufas. From beneath these *coulées* of old lava the Secondary rocks emerge in the coast sections, and in a few limited areas near the coast, where the trap has been denuded.

*Range of the beds.*—Separated from the valley of Strath by the three great ridges of the syenite mountains, the strata of the Lower Lias emerge near Sconser at the entrance of Loch Sligachan, and rise to several hundred feet on the north front of the syenitic mountain Glamaig. Southwards they are depressed and overlain by igneous rocks forming the floor of Glen Sligachan, and appear no more to the southward. They descend to the sea-level on the south-east side of Loch Sligachan; on the north-west side an Oolitic sandstone rises a little above the sea-level, this loch being in the line of a great fault. Thence to Camus-Inivaig Bay, 5 miles south of Portree, this sandstone appears at intervals in the coast section. On the east side of the bay the Inferior Oolite, Upper Lias, and Middle Lias emerge in succession from the sea-line, rising rapidly eastwards, the beds being successively lower in this direction till under the highest part of the cliff, 1346 feet in height, the lowest bed or Middle Lias attains a great thickness. From the summit of the vast arch the beds are again gradually depressed towards the north-west, disappearing in succession under the sea-line, so that the overlying trap occupies both sides of Portree harbour. North-east of the harbour the beds emerge again in the same order, rising northwards and attaining the greatest development found in Skye under the basaltic façades of Torvaig, 1280 feet in height. A denuded tract at the back of the cliffs, descending towards the base of the Storr, exhibits the highest beds of the series, so that, includ-

<sup>1</sup> *On the Jurassic Rocks of Skye and Raasay.* By James Bryce, M.A., LL.D., F.G.S. With a Palaeontological Appendix by Ralph Tate, Esq., A.L.S., F.G.S.

ing these beds and similar patches in front of the cliffs on the north side, the complete section to the sea-line exhibits the Middle and Lower Oolite, and the Upper and Middle Lias; the Lower Lias not appearing in the section, being doubtless depressed below the sea-line, as it rises to view and attains a considerable development on the east side of Raasay, opposite.

Northwards of the base of the Storr mountain and the above-mentioned section, the Liassic strata are no more seen in Skye; thence to Loch Staffin, about Loch Staffin, and in a denuded tract south-east of it, the only beds seen are those of the Inferior and Middle Oolite; the shores south of Staffin and the country inland by the base of the Quiraing mountain exhibit the Oxford Clay in great development; and the same stratum occurs on the shores of Uig Bay. Patches of the Lower and Middle Oolite occur at Aird and Duntulm near the sea-level, on opposite sides of the Ru-Hunish promontory; again at Mugstock on the west side of Loch Snizort, at Loch Bay in Vaternish, and at Vaterstein on the west side of Durinish.

*Sections and characteristic Fossils.*—A. Lower Lias. The beds of the Lower Lias on Loch Sligachan are of great thickness; calculating from the distance along the outcrop and the average dip it cannot be less than 800 feet. The ground under the base of Glamaig is so tossed and encumbered with detritus that a true section of the beds cannot be obtained. It can only be stated in a general way that the lower beds consist of altered shales, coarse sandstones and conglomerates, and the upper of indurated dark and gray limestones, and dark coloured shales. The more characteristic fossils are:—*Rhynchonella ammonitica*, *Avicula novemcostæ*, *Lima pectinoides*, *Pecten textorius*, *Gryphæa arcuata*, and *Belemnites infundibulum*; and these seem to shew by comparison with the beds at Broadford and Hallaig in Raasay that we are now on the horizon of *Ammonites Bucklandi*; at all three localities alike the main mass of the Lower Lias is thus characterized. Other fossils of these beds will be found in the subjoined lists.

B. Upper and Middle Lias, Tanna section *a*, in descending order: Upper Lias with *Ammonites communis* throughout.

	feet.	in.
1. Argillaceous dark-blue limestone, . . . . .	0	4
2. Black shales, . . . . .	3	0
3. Nodular blue limestone with pyrites; <i>Ammonites communis</i> and <i>A. falcifer</i> abundant and large, . . . . .	0	3
4. Black micaceous shales with <i>A. falcifer</i> , <i>A. heterophyllus</i> , <i>Inoceramus dubius</i> , &c., . . . . .	8	0
5. Brown crystalline limestone, . . . . .	0	6
6. Black friable shale, . . . . .	1	6
7. Compact blue limestone, . . . . .	1	3
8. Fine black shale with <i>A. bifrons</i> , . . . . .	0	9
	15	7

Under this comes the Middle Lias, same order, thickness seen about 60 feet.

1. Yellow calciferous sandstone, approximating to the limestone at the base of the Upper Lias; *Ammonites spinatus* beds.
2. Black micaceous sandstone with calcareous nodules and septaria; *A. margaritatus*, *Pecten aequivalvis*, *P. liasinus*, *Limæa acuticosta*, *Pentacrinus amalthei*.
3. Hard micaceous and calcareous shales with nodules; *Pecten aequivalvis*, very large, *Pholadomya ambigua*, *Plicatula spinosa*. Descends under the sea-line from Camus-Inivaig to Portree harbour.

The usual character of the upper beds of the Middle Lias is that of thick-bedded calcareous sandstones of a yellow or brown colour, very hard and tough, with crystalline limestone like a marble of the Carboniferous formation. The surface is often honey-combed, and lenticular masses with concentric structure occur in rows. The surface is also ridged with harder portions, the cement being iron or lime.

A good section of the Oolites cannot be had here in sequence, owing to the inaccessibility of the cliffs. The following is visible a little farther west. Tanna Section *b*, same order. There are three principal beds:—

1. A shaly crystalline limestone on the top, with shale partings, 15 inches, containing *Avicula costata*, *Ostrea Sowerbii*, *Rhynchonella concinna*, *Terebratula lagenalis*, and *Ammonites Murchisonæ*.
2. Middle beds, yellow or white sandstone, crumbling easily, about 50 feet thick, with imperfect plants and pieces of jet.
3. Lower portion, 100 feet of gray sandstones, with micaceous, argillaceous, and sandy beds; near the top, shales stained with carbon, and containing pieces of jet; on the top a blue calciferous sandstone; *Ammonites Murchisonæ*, *Pecten Dewalquei*, and *Lucina Wrightii* are characteristic; *Belemnites* of several species throughout, especially in the sandy beds; fossils most abundant in the lower beds.

Still further west No. 1 increases in thickness to 40 feet, and the series is very analogous to the beds of the Yorkshire coast.

Another section in this district, of easy access, the others being accessible only by boat and difficult to reach on the cliff, occurs at Camus-Inivaig Bay, and has much interest; order ascending from the sea-level:—

1. Middle Lias, a yellow calciferous sandstone with sandy shales.
2. Upper Lias, about 10 feet, without limestone.
3. Sandstones, Inferior Oolite, gray below, yellow above; stratification marked.
4. Sheet of compact dolerite, 60 feet; sinks westward, forming the tide-way; rises east, cuts bed No. 5, and runs into connection with the overlying trap.
5. Upper part of Lower Oolite, flaggy sandstone, bedding oblique, 40 feet.
6. Rocks of the basaltic plateau, overlying.

Bed No. 4 alters the contiguous strata remarkably; No. 5, where argillaceous, is turned to Lydian stone; where siliceous to a quartzite. Considerable layers of coal with jet occur in sandy beds near the lower junction. No. 4 plainly injected at the time of the formation of No. 6.

A section of the Oolites similar to the Tanna Section *b*, but of greater development and with more numerous and remarkable fossils, is had at the N.E. corner of Portree harbour; order descending:—

	feet.	in.
1. Basalt, . . . . .		
2. White gritty sandstone, about . . . . .	80	0
3. Shelly limestone, fissile above, thick-bedded below; fossils: <i>Cidaris</i> , sp. ? <i>Diastopora diluviana</i> , &c., . . . . .	43	6
4. Argillaceous sand-rock, with large spherical nodules of limestone, surface irregular; fossils numerous: <i>A. Murchisonæ</i> , <i>A. Humphreysianus</i> , <i>A. Strangewaysi</i> , <i>Belemnites giganteus</i> , <i>B. Gingensis</i> , <i>B. insculptus</i> , and <i>B. Blainvillæ</i> , <i>Pecten lens</i> , <i>Cidaris Fowleri</i> , . . . . .	120	0
5. Sandy shales and fissile limestone, . . . . .	40	0
6. Marine arenaceous limestone, . . . . .		
7. Soft sandstones and fissile sandstones; <i>A. Murchisonæ</i> , . . . . .	100	0
8. Calciferous sandstone with calcareous bombs; <i>A. Murchisonæ</i> , . . . . .		
	383	6

A little to the north of the highest point of Tor-Vaig mountain, 1280 feet, and nearly over the small cavity in the Middle Lias called Prince Charles' Cave, two remarkable sections are obtained upon the steep and difficult slopes; thirteen and eighteen beds are enumerated; they are thus generalized; order descending:—

#### OOLITES AND LIAS.

1. Basaltic covering.
2. Infra-Oxfordian estuarine beds; black *Estheria* shales; *Cyrena Brycei*.
3. Interposed basaltic sheet, rudely columnar, 35 feet.
4. Estuarine beds, black shales, and flaggy limestones, made up of shell fragments, same as No. 2; *Neritina Staflinensis*, *Cyprides*, small *Cyrenæ*, seeds of *Chara*, *Mytilus*, sp. ? *Valvata*, and fish remains.
5. Carbonaceous series, black shales and sandstones, 100 feet; Bath Oolite!
6. Basaltic sheet, interposed.
7. Inferior Oolite; upper series, limestones; middle, sandstones with *Belemnites Gingensis* and others, *Ostrea sublobata*, lower series, shales and sandstones, chiefly a massive sand rock and white sandstone with carbonaceous matter, *A. Murchisonæ*, *Belemnites Gingensis*, and *B. ventralis*, *Inoceramus*, *Pecten Dewalquei*, *Cypricardia*, *Cucullæa cucullata*, *Lucina Wrightii*.
8. Upper Lias.
9. Middle Lias to sea-level.

At the back of these lofty cliffs in the denuded tract, by two small lakes, in glens and water-courses, the estuarine beds with portions of the great *Ostrea Hebridica* bed, so well seen at Loch Staffin, were discovered by Dr. Bryce, with the following fossils, named by Mr. Tate: *Melania inermis*, *Neritina Staffinensis*, *Cyrena Brycei*, *Ostrea Hebridica*, and *Estheria Murchisonæ*.

The Loch Staffin beds are of the same age as the last; they rest upon a huge doleritic sheet, which appears on the tide-way all along the shore, the thickness seen being 40 feet, and probably separating these beds from the Inferior Oolite and Lias. The following may be taken as an average section; the ground, however, is difficult, the cliffs being in many parts inaccessible, and faulting frequent:—

#### LOCH STAFFIN BEDS. *Middle Oolite.*

1. Basalt overlying.
2. Limestone, and dark shale altered to Lydian stone, 3 to 4 feet.
3. Sandstone, yellow, weathering white, 4 to 5 feet, with *Neritina Staffinensis*, and a *Unio*.
4. Dark altered clays and shales with shelly courses, 4 to 5 feet; *Potomya Soverbii*, *Cyrena Jamesoni*, *Pholadomya acuticostata*, *Perna Murchisoni*, *Corbula MacNeillii*.
5. Limestone band, 4 feet.
6. The *Ostrea Hebridica* bed, 7 feet, literally a mass of oysters of great extent; it appears at other places, as Tor-Vaig, and the highest part of Raasay.
7. Sand rock, white and yellow, with carbonaceous matter, pieces of jet, and angular pieces of quartz; traversed horizontally by huge calcareous bombs. Contains *Cyrenæ*, chiefly in the upper parts, *Neritina Staffinensis*, &c.
8. Arenaceous limestone, 6 or 7 feet.
9. Thin-bedded flaggy limestones, 2 to 3 feet.
10. Black soft crumbling shales, 2 to 3 feet.
11. Gray calcareous and sandy shales with *Cyrenæ* and Oysters, 10 or 12 feet; total of Oolite, 70 feet.
12. The great doleritic sheet extending under water, probably the same as the second in the Portree section. It has greatly altered the beds in contact with it.

Superior to these beds of the Middle Oolite, the Oxford Clay extends round Staffin Bay, and out westwards, north of the base of Quiraing Mountain. It yielded *Ammonites Lamberti*, a characteristic fossil. It reappears round Uig Bay on Loch Snizort, and contains many interesting and critical fossils. These beds consist of adhesive clay, dark shales, and arenaceous limestone. The leading fossils at this locality are *Ammonites Jason*, *A. cordatus*, *A. Lamberti*, *Belemnites Owenii*, *B. sulcatus*, and *Littorina Meriani*.

The Duntulm beds are patches of estuarine limestone and Oxford Clay; the chief fossils are *Cyrenæ*, *Tellinæ*, *Belemnites*, and *Ammonites Kenigii*.

At Vaterstein, on the west coast of Durinish, a good vertical section of about 120 feet is obtained in the following order, descending:—

ESTUARINE BEDS AT VATERSTEIN.—*Middle Oolite.*

1. Basalt overlying, 3 feet 7 inches.
2. Shales and limestones, with *Paludina Scotica*, *Cyrena Cunninghami*, and fish remains; thin sheets of basalt.
3. Shell beds, containing *Ostrea Hebridica* and *Cyrena*.
4. Shell limestones, with *Cyrena*, shales, and marls.
5. Sandy beds and marls, fossils few and obscure.

Besides the above fossils the chief are those of Staffin and Torvaig, as *Melania inermis*, *Neritina Staffinensis*, *Cyrena Brycei*, and *C. Maccullochii*.

RAASAY.

In Raasay the Jurassic strata occupy a larger exposed area than in Skye, being uncovered by trap through a considerable area, as will be seen by reference to the map and sections accompanying Dr. Bryce's paper. The sections present a succession very similar to those already given; it will not, therefore, be necessary to multiply them. The only fossils known to Dr. Bryce as having been found in these beds before he began his researches were those given by Sir R. I. Murchison, viz. *Ammonites Conybeari*, *Plicatula spinosa*, and *Gryphæa gigantea* (Sow. Min. Conch. tab. 131, 245, 391), all stated to have been found near the north-west end of Raasay. There is no reference to any bed or section.

The Raasay sections start from a lower horizon than in the Portree cliffs opposite. On the east shore, north of Hallaig, at the headland of Ru-na-Leac, near a waterfall, a basaltic sheet occupies the shore. Over this, at the base of Ru-na-Leac, rest thick beds of breccia and conglomerates, composed of Torridon sandstone and quartzite, succeeded by finer conglomerates, coarse and also mottled sandstones. They are unfossiliferous, but as they are conformable to the overlying Lower Lias, they may be regarded as of Rhaetic age. Their thickness is 150 feet. To these succeeds the Lower Lias, having here a breadth across the outcrop of 3000 feet, the dip being 10° to 7°. The estimated thickness is 550 feet. On the north side of the bay the Lower Lias occupies two scarped cliffs, the under cliff consisting of compact blue limestone weathering white, shales and oyster bands. The few fossils and stratigraphical position fix the horizon as that of the zones of *Ammonites planorbis* and *A. angulatus*. The higher cliff consists of alternations of shales, Gryphite beds and earthy limestones below, passing up into sandy beds and calciferous sandstone with fossils common to the zone of *Ammonites Bucklandi*. The upper part of the cliff consists of a greenish-yellow calcareous sandstone with scattered *Gryphæa arcuata*.



The stream, here descending over the cliff, and forming a fine waterfall, runs along the course of a fault, on the north side of which the Rhaetic beds and Lower Lias are brought up against the Middle Lias and Inferior Oolite.

## LITHOLOGY AND FOSSILS OF THE LOWER LIAS.

Lithology.	Thickness.	Fossils.
	ft. in.	
1. Indurated shales.....	7 0	
2. Indurated shales, with impure limestone courses.....	4 9	
3. Gryphite bed.....	1 0	<i>Gryphæa arcuata</i> , <i>Rhynchonella ammonitica</i> , <i>Ammonites sinemuriensis</i> .
4. Indurated shale.....	0 6	<i>Pecten textorius</i> , <i>Cidaris Edwardsii</i> .
5. Gryphite bed.....	0 6	<i>Gryphæa arcuata</i> , <i>Pinna Hartmanni</i> .
6. Shale.....	0 6	<i>Belemnites infundibulum</i> .
7. Gryphite bed.....	0 9	<i>Gryphæa arcuata</i> , <i>Pecten textorius</i> , <i>Pentacrinus</i> .
8. Indurated shale.....	1 0	<i>Belemnites infundibulum</i> .
9. Gryphite bed, with shale parting. (Top of 1st scar.).....	1 2	<i>Gryphæa arcuata</i> , <i>Lima gigantea</i> , <i>Spiriferina Walcottii</i> .
10. Impure indurated limestone. (2d scar.).....	4 1	<i>Belemnites infundibulum</i> , <i>Gryphæa arcuata</i> .
11. Soft shale.....	0 4	
12. Massive impure limestone.....	0 10	
13. Gryphite.....	0 10	<i>Ammonites bisulcatus</i> , <i>Rhynchonella ammonitica</i> , <i>Pinna Hartmanni</i> , <i>Cardinia crassiuscula</i> .
14. Soft shelly shales.....	2 0	<i>Lima pectinoides</i> , <i>Pecten Thollierei</i> , <i>Rhynchonella ammonitica</i> , <i>Waldheimia perforata</i> , many <i>Gasteropoda</i> .
15. Sandy shales and limestone.....	2 10	
16. Sandy shales and gryphite bed. (2d scar.).....	2 7	
17. Sandy shales.....	1 3	<i>Pleuromya galathea</i> , <i>Spiriferina Walcottii</i> .
18. Gryphite bed.....	0 3	
19. Sandy shales.....	1 6	<i>Gryphæa arcuata</i> , <i>Lima gigantea</i> , <i>Spiriferina Walcottii</i> , <i>Belemnites</i> .
20. Shale, with line of black nodules.....	2 7	
21. Shale.....	1 3	<i>Ammonites Saueanus</i> .
22. Indurated shale.....	2 3	
23. Gryphite bed, very fossiliferous.....	0 7	<i>Cardinia Listeri</i> , <i>Pleurotomaria similis</i> , &c.
24. Indurated shale.....	1 10	
25. Shales and thick masses of <i>Rhynchonella</i> .....	4 0	<i>Cardinia Listeri</i> , <i>Lima pectinoides</i> .
26. Sandy shales.....	6 0	Scattered <i>Gryphæa arcuata</i> .
27. <i>Gryphæa</i> beds (sandy matrix).....	15 6	
28. { Shaly sands.....	9 6	
{ <i>Gryphæa</i> beds.....		
{ Sandy beds.....		
29. { Sandy limestone.....	15 0	<i>Ammonites bisulcatus</i> , <i>Spiriferina Walcottii</i> , <i>Rhynchonella ammonitica</i> , <i>Pholadomya Fraasii</i> , <i>Pleuromya galathea</i> , <i>Lima pectinoides</i> , <i>Ammonites bisulcatus</i> .
{ Sandstone.....		
{ Calcareous sandstone.....		
Total.....	92 7	

The higher beds of the Lower Lias in the Waterfall Cliff come

down to the sea-shore as we advance northward; and now a sudden change takes place both in the lithology and life. Sandstones almost unfossiliferous are surmounted by soft micaceous shales with lines of ironstone doggers, and crowded with well-preserved fossils, prominent among which are large specimens of *Ammonites armatus*, *Hippopodium ponderosum*, and *Pholadomya decorata*. These are succeeded by harder shales with *Ammonites Jamesoni*, and are the northern prolongation of the Pabba beds.

The Middle Lias succeeds. It has a great development, occupies a large area, and indeed is a great feature of Raasay. The following section, in descending order, was obtained almost under Dun-Càn, in the steep cliffs north of the waterfall. It measures about 150 feet from the base of the Inferior Oolite to the sea-level.

1. Yellow calciferous sandstone with nodules.
2. Bluish-green calciferous, and
3. Shelly ferruginous sandstone.
4. Marly sandstone.
5. Gray marls.
6. Greenish-yellow sandstone with
7. Shaly partings.
8. Yellowish sandstone.
9. Greenish marly sand-beds.
10. Greenish-yellow calciferous sandstone.
11. Greenish calciferous sandstone with indurated upper layer.

Here No. 1 is the *Ammonites spinatus* bed; Nos. 2-8 the *A. margaritatus* beds; Nos. 9-11 the *A. capricornus* beds. The fossils of No. 1 are *Ammonites spinatus*, *Lima Hermannii*, *Pecten æquivalvis*, *Gresslya Sebachii*, *Ostrea cymbium*, *Avicula novemcostæ*, *Rhynchonella acuta*, *R. tetrahedra*, and *Waldheimia resupinata*; in Nos. 2-8 inclusive, *Ammonites margaritatus*, *Isocardia Liassica*, *Pleuromya*?, *Pecten æquivalvis*, *Mytilus scalprum*, *Ostrea cymbium*, *Spiriferina rostrata*, and *Rhynchonella tetrahedra*; in Nos. 9-11, *A. capricornus*, *Hippopodium ponderosum*, *Plicatula spinosa*, *Ostrea cymbium*, var. *Maccullochii*; in No. 10, *Modiola scalprum*, *Pleuromya ovata*, *Pinna folium*, *Plicatula spinosa*, *Cuccullæa Münsteri*, *Pholadomya decorata*, and *Pecten æquivalvis*. The series of beds here and in other parts of Raasay, as well as that portion of the Middle Lias at Broadford, is correlative with the beds at Huntcliff, Yorkshire. On the Hallaig shore in Raasay the community of species is so great, though the mineral characters are somewhat distinct, that there is not much value in detaching the *Ammonites armatus* beds from those of *A. Jamesoni*. In Church Bay the *Ammonites armatus* shales of this division are overlain and altered by felstone. The chief fossils noted there were *Ammonites tardecrescens*, *Pinna folium*, *Pholadomya decorata*, and *Avicula novemcostæ*. The beds above the zone of *Ammonites Jamesoni* are exposed in the cliffs on Hallaig Moor, and form a grand section on the east coast.

No traces were found in Raasay of the Upper Lias formation, but it is possible it may exist in front of the steep eastern cliffs. The mural character of this cliff renders it impossible to obtain a good section of the Oolites. The estuarine beds of the Middle Oolite form the sloping brow between the top of the cliffs and the base of Dun-Càn, round whose crown-like basaltic top, 1443 feet high, they emerge on all sides. Here fragments are found of the *Ostrea Hebridica* bed at a much greater elevation than it attains at Tor-Vaig or in any other part of the Jurassic area. A singular interest attaches to it in this elevated and isolated position.—The beds on the west coast of Raasay, opposite Portree, consist of superior Oolitic sandstones and flaggy gritty limestones, surmounted by the soft sandstones of the Bath Oolite series.

The mineral characters of the beds have a remarkable similarity over the whole area and a close resemblance in this respect and in fossils to the great series of Yorkshire, and even in the coal beds and jet of the sandy Oolite. The area presents also the same evidence of the alternation of marine and estuarine, almost fresh-water deposits, as seen in the marine fossils of Staffin, the estuarine towards Portree and Tor-Vaig, and those of a fresh-water character at Loch Bay and Vaterstein—all pointing, as in other areas, to great oscillations of the land.

## LIST OF THE JURASSIC FOSSILS OF SKYE, RAASAY, AND MULL.

The locality for almost all the Lower Lias fossils is near Sconser, on Loch Sligachan, in Skye; and in Raasay, Ru-na-Leac promontory, near the water-fall; for those of the Middle Lias, the S. side of Portree harbour chiefly, also the N. side over Prince Charles' Cave; in Raasay, Hallaig Moor, S.E. of Dun-Càn, and the roadside on the top of the hill leading to Hallaig; for those of the Upper Lias, S. side of Portree harbour at Tanna point, and the cliffs above Prince Charles' Cave, N. of Portree.

### I. LOWER, MIDDLE, AND UPPER LIAS.

#### Actinozoa.

ISASTRÆA, *M. Edwards.*  
Murchisoni, *Wright.*

Lower Lias, Lussay.

#### Echinodermata.

CIDARIS, *Lamarck.*  
Edwardi, *Wright.*

Lower Lias, Lussay and Raasay.

PENTACRINUS, *Miller.*  
amalthæi,  
gracilis, *Charlesw.*  
lævis, *Miller.*  
robustus, *Wright.*

Middle Lias, Portree.  
Middle Lias, Pabba.  
Middle Lias, Pabba.  
Middle Lias, Pabba.

**Annelida.****DITRYPA.**

- circinatum*, *Tate*. Middle Lias, Pabba and Raasay.  
*quinguesulcatum*, *Goldfuss*, sp. Middle Lias, Pabba, Raasay, and Portree.

**Crustacea.****PSEUDOGLYPHEA.**

Middle Lias, Raasay.

**Brachiopoda.****LINGULA**, *Bruguière*.

*Voltzii*,

Middle Lias, Raasay.

**RHYNCHONELLA**, *Fischer*.

*acuta*, *Sow*.

Middle Lias, Raasay; Portree.

*furcillata*, *Theodor*.

Middle Lias, Raasay.

*plicatissima*, *Quenst*.

Lower Lias, Broadford.

*var. ammonitica*.

Lower Lias, Raasay; Broadford.

*rimosa*, *Buckl*.

Middle Lias, Mull; Pabba.

*subconcinna*, *Dav*.

Middle Lias, Portree.

*tetrahedra*, *Sow*.

Middle Lias, Pabba; Mull; Portree; Raasay.

*variabilis*, *Schloth*.

Middle Lias, Mull; Raasay; Portree; Pabba.

**SPIRIFERINA**, *D'Orbigny*.

*Münsteri*, *Dav*.

Middle Lias, Raasay.

*oxyptera*, *Buvig*.

Middle Lias, Mull; Raasay.

*rostrata*, *Schloth*.

Middle Lias, Mull; Raasay.

*verrucosa*, *V. Buch*.

Middle Lias, Raasay.

*Walcotti*, *Sow*.

Lower Lias, Raasay; Mull.

**TEREBRATULA**, *Lhuys*.

*punctata*, *Sow*.

Middle Lias, Mull; Raasay; Portree; Pabba.

**WALDHEIMIA**, *King*.

*numismalis*, *Lam*.

Middle Lias, Mull; Raasay.

*perforata*, *Piette*.

Lower Lias, Raasay.

*resupinata*, *Sow*.

Middle Lias, Portree.

**Lamellibranchiata—Monomyaria.****AVICULA**, *Klein*.

*cygnipes*, *Phil*.

Middle Lias, Raasay.

*inæquivalvis*, *Sow*.

Middle Lias, Mull.

*novemcostæ*, *Brown*.

Middle Lias, Pabba; Raasay; Lower Lias, Sligachan; Broadford.

**GERVILLIA**, *DeFrance*.

*Maccullochii*, *Wright*.

Middle Lias, Pabba.

**GRYPHÆA**, *Lamarck*.

*cymbium*, *Lam*.

Middle Lias, Pabba; Mull.

*incurva*, *Sow*.

Middle Lias, Raasay.

*obliquata*, *Sow*.

Middle Lias, Mull; Pabba; Raasay.

**HINNITES**, *DeFrance*.

*tumidus*, *Ziet*.

Upper Lias, Portree.

- INOCERAMUS**, *Sowerby*.  
*dubius*, *Sow.*  
*ventricosus*, *Sow.*  
 Upper Lias, Portree.  
 Middle Lias, Pabba; Raasay.
- LIMA**, *Bruguière*.  
*eucharis*, *D'Orb.*  
*gigantea*, *Sow.*  
 Middle Lias, Pabba.  
 Middle Lias, Pabba; Lower Lias, Raasay.  
*scabricula*,  
*Hermanni*, *Ziet.*  
 Middle Lias, Portree.  
 Middle Lias, Raasay; Portree;  
 Pabba; Mull.  
*pectinoides*, *Sow.*  
*punctata*, *Sow.*  
 Lower Lias, Broadford; Raasay.  
 Lower Lias, Raasay; Broadford.
- LIMEA**, *Bronn*.  
*acuticoستا*, *Goldf.*  
 Middle Lias, Mull; Pabba; Portree;  
 Hallaig Moor, Raasay.
- OSTREA**, *Linné*.  
*arietis*, *Quenst.*  
*irregularis*, *Münst.*  
 Lower Lias, Lussay.  
 Lower Lias, Raasay; Middle Lias,  
 Broadford.  
*arcuata*,  
 Lower Lias, Raasay.
- Pecten**, *Linné*.  
*aequivalvis*, *Sow.*  
 Middle Lias, Raasay; Portree;  
 Pabba.  
*corneus*, ? *Goldf.*  
*Hehlii*, *D'Orb.*  
*liasinus*, *Nyst.*  
 Middle Lias, Pabba.  
 Lower Lias, Raasay; Broadford.  
 Middle Lias, Pabba; Hallaig, Raasay;  
 Portree.  
*personatus*, *Ziet.*  
*pollux*, *D'Orb.*  
*priscus*, *Schloth.*  
*strionates*,  
 Upper Lias; Portree.  
*sublaevis*, *Phil.*  
*textorius*, *Schloth.*  
*Thiollieri*, *Martin.*  
*velatus*, *Goldf.*  
 Lower Lias, Raasay.  
 Middle Lias, Mull.
- PERNA**, *Bruguière*.  
*infraliasina*, *Quenst.*  
 Lower Lias, Raasay.
- PINNA**, *Linné*.  
*folium*, *Young & Bird.*  
*Hartmanni*, *Ziet.*  
*tetragona*, *Sow.*  
 Middle Lias, Raasay; Mull; Pabba.  
 Lower Lias, Raasay; Broadford.  
 Middle Lias, Mull.
- PLICATULA**, *Lamarck*.  
*Dealongchampsii*, *Terq.*  
*spinosa*, *Sow.*  
 Lower Lias, Raasay.  
 Middle Lias, Mull; Portree; Pabba;  
 Raasay.
- PTEROPERNA**, *Lycett*.  
*Pabbaensis*, *Wright, MS. (?)*.  
 Middle Lias, Pabba.
- Lamellibranchiata.—Dimyaria.**
- ARCA**, *Linné*.  
*Buckmani*, *Richm.*  
*elongata*, *Buck.*  
 Middle Lias, Mull.  
 Middle Lias, Mull.

<b>ARCA</b> — <i>continued</i> .	
<i>Stricklandi, Tate.</i>	Middle Lias, Portree.
<i>truncata, Buckm.</i>	Middle Lias, Mull.
<b>ARCOMYA, Agassiz.</b>	
<i>arcacea, Seeb.</i>	Middle Lias, Raasay.
<i>vetusta, Phil. sp.</i>	Middle Lias, Pabba.
<b>ASTARTE, Sowerby.</b>	
<i>amalthæi, Quenst.</i>	Middle Lias, Portree.
<i>Gueuxii, D'Orb.</i>	Lower Lias, Leac, Raasay.
<i>Pailonoti, Quenst.</i>	Middle Lias, Mull.
<i>striatosulcata, Röm.</i>	Middle Lias, Pabba.
<b>CARDINIA, Agassiz.</b>	
<i>attenuata, Stutch.</i>	Middle Lias, Raasay.
<i>concinna, Sow.</i>	Lower Lias, Lussay.
<i>crassiuscula, Sow.</i>	Lower Lias, Leac, Raasay.
<i>Listeri, Sow.</i>	Lower Lias, Raasay; Broadford.
<b>CARDITA, Bruguière.</b>	
<i>multicosta, Phil.</i>	Middle Lias, Raasay.
<b>CARDIUM, Linné.</b>	
<i>Phillipianum, Dunker.</i>	Lower Lias, Broadford; Raasay.
<i>truncatum, Sow.</i>	Middle Lias, Raasay; Portree.
<b>CEROMYA, Agassiz.</b>	
<i>liasica, Moore.</i>	Middle Lias, Raasay.
<b>CUCULLÆA, Lamarck.</b>	
<i>Münsteri, Goldf.</i>	Middle Lias, Raasay.
<b>CYPRICARDIA, Lamarck.</b>	
<i>cucullata, Goldf.</i>	Middle Lias, Portree; Raasay.
<b>GRESSLYA, Agassiz.</b>	
<i>Anglica, Ag.</i>	Middle Lias, Mull.
<i>Sebachii,</i>	Middle Lias, Portree.
<b>HIPPOPODIUM, Sow.</b>	
<i>ponderosum, Sow.</i>	Middle Lias, Mull; Pabba; Raasay.
<b>LEDA, Schumacher.</b>	
<i>galathea, D'Orb.</i>	Middle Lias, Raasay.
<i>graphica, Tate.</i>	Middle Lias, Raasay.
<i>rostralis, Lam.</i>	Middle Lias, Mull.
<i>Zieteni, Brauns.</i>	Middle Lias, Raasay.
<b>ISOCARDIA, Lamarck.</b>	
<i>liasica, Tate.</i>	Middle Lias, Mull.
<b>MACRODON, Lycett.</b>	
<i>liasinum, Tate.</i>	Middle Lias, Raasay.
<i>Hettangiensis, Terq.</i>	Lower Lias, Broadford; Raasay.
<b>MYACITES, Bronn.</b>	
<i>longissimus, Quenst.</i>	Middle Lias, Pabba.
<b>MYTILUS, Linné.</b>	
<i>cuneatus, Phil.</i>	Middle Lias, Pabba.
<i>Gueuxii, D'Orb.</i>	Lower Lias, Raasay.
<i>Hillanus, Sow.</i>	Lower Lias, Raasay; Middle Lias, Mull.
<i>numismalis, Oppel.</i>	Middle Lias, Raasay.
<i>scalprum, Sow.</i>	Middle Lias, Pabba; Raasay; Mu

NUCULA, <i>Lamarck.</i> subglobosa, <i>Röm.</i>	Upper Lias, Portree, Northcliffs and Tanna point.
PHOLADOMYA, <i>Sowerby.</i> ambigua, <i>Sow.</i>	Middle Lias, Mull; Portree; Raasay; Pabba.
decorata, <i>Goldf.</i>	Middle Lias, Pabba; Raasay.
Fraasii, <i>Oppel.</i>	Lower Lias, Raasay.
PLEUROMYA, <i>Agassiz.</i> galathea, <i>Ag.</i>	Lower Lias, Raasay.
liasina, <i>Ag.</i>	Lower Lias, Raasay.
ovata, <i>Röm.</i>	Middle Lias, Pabba; Raasay; Portree.
Scotica, <i>Wright.</i>	Middle Lias, Pabba; Mull.
unioides, <i>Röm.</i>	Middle Lias, Mull; Pabba.
UNICARDIUM, <i>D'Orbigny.</i> cardioides, <i>Phil.</i>	Lower Lias, Raasay; Middle Lias, Mull; Pabba.
Ianthe, <i>D'Orb.</i>	Middle Lias, Pabba; Raasay; Portree.
TANCREDIA, <i>Lycett.</i> axiniformis, <i>Phil.</i>	Middle Lias, Raasay.
<b>Gasteropoda.</b>	
CERITHIUM, <i>Adanson.</i> Slatteri, <i>Tate.</i>	Middle Lias, Raasay.
CHEMNITZIA, <i>D'Orbigny.</i> Blainvillei, <i>Benz.</i>	Middle Lias, Raasay; Pabba; Portree.
CRYPTÆNIA, <i>Deslongchamps.</i> polita, <i>Sow.</i>	Lower Lias, Raasay; Broadford.
expansa, <i>Sow. sp.</i>	Middle Lias, Portree.
EUCYCLUS, <i>Deslongchamps.</i> elegans, <i>Goldf.</i>	Lower Lias, Raasay; Broadford.
NATICA, <i>Adanson.</i> pilula, <i>Tate.</i>	Upper Lias, Portree.
ONUSTUS, <i>Humphrey.</i> heliaceus, <i>D'Orb.</i>	Upper Lias, Portree.
PHASIANELLA, <i>Lamarck.</i> Morencyana, <i>Terq. &amp; Piette.</i>	Lower Lias, Raasay.
PLEUROTOMARIA, <i>DeFrance.</i> Anglica, <i>Sow.</i>	Lower Lias, Lussay.
similis, <i>Sow.</i>	Lower Lias, Raasay.
TECTABIA, <i>Cuvier.</i> capitanea, <i>Goldf.</i>	Upper Lias, Portree.
Gaudryana, <i>D'Orb.</i>	Middle Lias, Portree.
imbricata, <i>Sow.</i>	Middle Lias, Pabba; Raasay.
TURBO, <i>Linné.</i> solarium, <i>Piette.</i>	Lower Lias, Raasay.

**Cephalopoda.****AMMONITES, Bruguière.**

armatus, *Sow.*  
 bifrons, *Phil.*  
 bisulcatus, *Brug.*  
 brevispina, *Sow.*  
 capricornus, *Schloth.*  
 communis, *Sow.*  
 Davoei, *Sow.*  
 gracilis, *Buckm.*  
 difformis, *Em.*  
 falcifer, *Sow.*  
 Henleyi, *Sow.*  
 heterophyllius, *Sow.*  
 Jamesoni, *Sow.*  
 margaritatus, *Montf.*  
 multicostatus, *Sow.*  
 polymorphus, *D'Orb.*  
 varicostata, *Ziet.*  
 Sauzeanus, *D'Orb.*  
 semicostatus, *Young and Bird.*  
 sinemuriensis, *D'Orb.*  
 spinatus, *Brug.*  
 striatulus, *Sow.*  
 tardecrescens, *D'Orb.*  
 variabilis, *D'Orb.*  
 ziphus, *Ziet.*

**BELEMNITES, Ehrhart.**

breviformis, *Voltz.*  
 clavatus, *Schloth.*  
 elegans, *Simpson.*  
 elongatus, *Miller.*

infundibulum, *Phil. (?)*  
 inornatus, *Phil.*  
 longissimus, *Müller.*  
 microstylus, *Phil.*  
 paxillosus, *Voltz.*  
 umbilicatus, *Blainv.*  
 Voltzii, *Phil.*

**NAUTILUS, Breynius.**

striatus, *Sow.*

Middle Lias, Raasay.  
 Upper Lias, Portree.  
 Lower Lias, Raasay; Broadford.  
 Middle Lias, Pabba; Raasay.  
 Middle Lias, Raasay.  
 Upper Lias, Portree.  
 Middle Lias, Pabba; Portree.  
 Middle Lias, Raasay.  
 Lower Lias, Raasay; Broadford.  
 Upper Lias, Portree.  
 Middle Lias, Raasay.  
 Upper Lias, Portree.  
 Middle Lias, Pabba; Raasay.  
 Middle Lias, Raasay; Portree.  
 Lower Lias, Lussay.  
 Middle Lias, Raasay.  
 Middle Lias, Mull.  
 Lower Lias, Raasay; Broadford.  
 Lower Lias, Lussay.  
 Lower Lias, Raasay.  
 Middle Lias, Portree.  
 Upper Lias, Portree.  
 Middle Lias, Church Bay, Raasay.  
 Upper Lias, Portree.  
 Lower Lias, Raasay.

Middle Lias, Pabba; Raasay.  
 Middle Lias, Pabba; Portree.  
 Middle Lias, Raasay.  
 Middle Lias, Pabba; Raasay; Portree.  
 Lower Lias, Raasay; Sligachan.  
 Upper Lias, Portree.  
 Middle Lias, Raasay.  
 Middle Lias, Portree.  
 Middle Lias, Pabba; Portree.  
 Middle Lias, Raasay.  
 Upper Lias, Portree.

Upper Lias, Portree.

**II. LOWER AND MIDDLE OOLITE.****Plantæ.**

Obscure Cycads and Ferns.

**Echinodermata.****CIDARIS, Lamarck.**

Fowleri, *Wright.*

Inferior Oolite, Scoribrae, Portree.

H



**Annelida.**

SERPULA, *Linné*.  
     *plicatilis*, *Goldf.*  
     *tetragona*, *Sow.*

Oxford Clay, Uig.  
 Oxford Clay, Uig.

**Crustacea.**

ESTHERIA, *Rüppell*.  
     *Murchisonæ*, *Jones.*

Middle Oolite, Staffin; Tor-Vaig.

**Polymoa.**

DIASTOPORA, *Lamouroux*.  
     *diluviana* (?), *M. Edw.*

Inferior Oolite, Scoribrae.

**Brachiopoda.**

RHYNCHONELLA, *Fischer*.  
     *concinna* (?), *Sow.*  
 TEREBRATULA, *Lhwyl*.  
     *lagenalis*, ? *Schloth.*  
     *perovalis*, *Sow.*

Inferior Oolite, Portree.  
 Inferior Oolite, Portree.  
 Inferior Oolite, Portree.

**Lamellibranchiata.—Monomyaria.**

ANOMIA, *Linné*.  
     *estuarina*, *Tate.*  
 AVICULA, *Klein*.  
     *costata*, *Sow.*  
     *inæquivalvis*, *Sow.*

Estuarine beds, North Cliffs, Portree.  
 Inferior Oolite, Portree.  
 Inferior Oolite, Portree; Oxford  
 Clay, Uig.

INOCERAMUS, *Sowerby*.  
     *amygdaloides*, ? *Goldf.*  
 LIMA, *Bruguière*.  
     *gibbosa*, *Sow.*

Inferior Oolite, Portree.  
 Inferior Oolite, Portree.

OSTREA, *Linné*.  
     *dilatata*, *Sow.*  
     *Hebridica*, *Forbes.*

Oxford Clay, Uig.  
 Estuarine beds, Vaterstein; Staffin;  
 Loch Bay; Loch Leathan; Dun-  
 Càn; Raasay.

*Sowerbii*, *Lyc. and Morris.*  
*sublobata*,

Inferior Oolite, Portree.  
 Inferior Oolite, Portree.

PECTEN, *Linné*.  
     *arcuatus*, *Sow.*  
     *Dewalquesi*, *Op.*  
     *lens*, *Sow.*

Oxford Clay, Uig.  
 Inferior Oolite, Portree.  
 Inferior Oolite, Scoribrae.

PERNA, *Bruguière*.  
     *Murchisoni*, *Forbes.*

Estuarine beds, Staffin; North Cliffs,  
 Portree.

PINNA, *Linné*.  
     *mitis*, *Phil.* (?)

Oxford Clay, Uig.

**Lamellibranchiata.—Dimyaria.**

CORBULA, *Bruguière*.  
     *Hebridica*, *Tate.*  
     *MacNeillii*, *Morris.*

Estuarine beds, Loch Bay.  
 Estuarine beds, Staffin.

<b>CUCULLÆA</b> , <i>Lamarck.</i>	
<i>cancellata</i> , <i>Phil.</i>	Inferior Oolite, Portree.
<i>concinna</i> , <i>Phil.</i>	Oxford Clay, Uig.
<b>CYRENA</b> , <i>Lamarck.</i>	
<i>arata</i> , <i>Forbes.</i>	Estuarine beds, Staffin.
(Miodon) <i>Brycei</i> , <i>Tate.</i>	Estuarine beds, Tor-Vaig; Staffin;
	Loch Bay.
<i>cucullata</i> , <i>Tate.</i>	Estuarine beds, Loch Bay.
(Miodon) <i>Cunninghami</i> , <i>Forbes.</i>	Estuarine beds, Staffin; Vaterstein;
	North Cliffs, Portree.
(Miodon) <i>Jamesoni</i> , <i>Forbes.</i>	Estuarine beds, Staffin.
<i>Maccullochii</i> , <i>Forbes.</i>	Estuarine beds, Staffin; Vaterstein.
<b>LUCINA</b> , <i>Bruguière.</i>	
<i>Wrightii</i> , <i>Op.</i>	Inferior Oolite, Portree.
<b>MYTILUS</b> , <i>Linné.</i>	
<i>cuneatus</i> , <i>Sow.</i>	Estuarine beds, Loch Bay.
<i>lithodomus</i> , <i>Koch and Dunker.</i>	Estuarine beds, North Cliffs, Portree.
<i>sublævis</i> , <i>Sow. (?)</i>	Estuarine beds, Loch Bay.
<b>NUCULA</b> , <i>Lamarck.</i>	
<i>elliptica</i> , <i>Phil.</i>	Oxford Clay, Uig.
<i>Hammeri</i> , <i>Defr.</i>	Inferior Oolite, Portree.
<i>pollux</i> ,	Oxford Clay, Uig.
<b>PHOLADOMYA</b> , <i>Sowerby.</i>	
<i>acuticostata</i> , <i>Sow.</i>	Estuarine beds, Staffin.
<i>Protei</i> , <i>Ag.</i>	Oxford Clay, Uig.
<b>PLEUROMYA</b> , <i>Agassiz.</i>	
<i>Jurassi</i> , <i>Brongn.</i>	Inferior Oolite, Portree.
<b>POTAMOMYA</b> , <i>Sowerby.</i>	
<i>robusta</i> , <i>Tate.</i>	Estuarine beds, Loch Bay.
<i>Sedgwickii</i> , <i>Forbes.</i>	Estuarine beds, Staffin.
<i>Sowerbii</i> , <i>Forbes.</i>	Estuarine beds, Staffin.
<b>TRIGONIA</b> , <i>Bruguière.</i>	
<i>tripartita</i> , <i>Forbes.</i>	Estuarine beds, Staffin.
<b>UNIO</b> , <i>Retzius.</i>	
? <i>Staffinensis</i> , <i>Forbes.</i>	Estuarine beds, Staffin.

**Gasteropoda.**

<b>DENTALIUM</b> , <i>Linné.</i>	
<i>entaloides</i> , <i>Desl.</i>	Inferior Oolite, Portree.
<b>HYDROBIA</b> , <i>Hartm.</i>	
<i>Caledonica</i> , <i>Tate.</i>	Estuarine beds, Loch Bay.
<i>præcursor</i> , <i>Sandberger (H. conulus,</i>	
<i>Forbes).</i>	Estuarine beds, Staffin.
<b>LEPTOXIS</b> ,	
<i>trochiformis</i> , <i>Tate.</i>	Estuarine beds, Loch Bay.
<b>LITTORINA</b> , <i>Férussac.</i>	
<i>Meriani</i> , <i>Goldfuss.</i>	Oxford Clay, Uig.
<b>MELANIA</b> , <i>Lamarck.</i>	
? <i>inermis</i> , <i>Tate.</i>	Estuarian beds, Vaterstein; Tor-
	Vaig, North Cliffs, Portree.

**NERITINA, Lamarck.**  
*arata, Tate.*  
*Staffinensis, Forbes.*

Estuarian beds, Loch Bay.  
 Estuarian beds, Tor-Vaig; Staffin;  
 North Cliffs, Portree; Loch Bay.

**PALUDINA, Lamarck.**  
*Scotica, Tate.*

Estuarine beds, Loch Bay; Vater-  
 stein.

**VALVATA, Müller.**  
*præcursor, Tate.*

Estuarine beds, North Cliffs, Portree.

### Cephalopoda.

**AMMONITES, Bruguière.**  
*comensis, D'Orb.*  
*cordatus, Sow.*  
*Eugenii, Raspail.*  
*Humphriesianus, Sow.*  
*Jason, D'Orb.*  
*Koenigi, Sow.*  
*Lamberti, Sow.*  
*Murchisonæ, Sow.*

Inferior Oolite, Portree.  
 Oxford Clay, Uig.  
 Oxford Clay, Staffin.  
 Inferior Oolite, Scoribrae.  
 Oxford Clay, Uig.  
 Oxford Clay, Duntulm.  
 Oxford Clay, Uig; under the Quiraing.  
 Inferior Oolite, Scoribrae; S. Cliffs,  
 Portree.  
 Inferior Oolite, Scoribrae.  
 Inferior Oolite, Portree.  
 Oxford Clay, Staffin.

*Strangwaysii, Sow.*  
*subradiatus, Sow.*  
*Vernoni, Phil. (?)*

**BELEMNITES, Ehrhart.**  
*Aalensis, Voltz.*  
*Blainvillei, Voltz.*  
*confertus, Tate.*

Inferior Oolite, Portree.  
 Inferior Oolite, Scoribrae.  
 Inferior Oolite, south side Portree  
 Harbour.

*Gingensis, Oppel.*  
*giganteus, Schloth.*  
*insculptus, Phil.*  
*Owenii, Pratt.*  
*parallelus, Phil.*  
*pectinatus, Tate.*

Inferior Oolite, Scoribrae.  
 Inferior Oolite, Scoribrae.  
 Inferior Oolite, Scoribrae.  
 Oxford Clay, Uig.  
 Inferior Oolite, Portree.  
 Inferior Oolite, south side Portree  
 Harbour.

*rostriformis, Quenst.*  
*sulcatus, Miller.*  
*ventralis, Phil.*

Inferior Oolite, Portree.  
 Oxford Clay, Uig.  
 Inferior Oolite, Portree.

### Pisces.

**HYBODUS, Agassiz.**  
*polyprion, Ag., and fish scales.*

Estuarine beds, Loch Bay, Vater-  
 stein; North Cliffs, Portree.

## THE TERTIARY FORMATION IN WESTERN SCOTLAND.

The only fossils belonging to the Tertiary formation found in Scotland are the plant remains contained in the mud-beds, inter-bedded between trap-tuffs and sheets of basalt at the headland of Ardtun in the south-west corner of the Isle of Mull. An account of the strata is given in a paper "On the Tertiary Leaf-beds in the Isle of Mull," by the Duke of Argyll; with a note on the vegetable remains from Ardtun Head, by Professor Edward Forbes, contained in the *Quart. Journ. Geol. Soc. of London*, vol. vii. p. 89. Figures of about nine species are given and named provisionally, a list of which we reproduce. They were believed by Professor Forbes to be of the age of the Miocene period. Little, if indeed anything, appears to have been done in the way of more extended investigation into this interesting Miocene flora, so that our information in this branch of Western Scottish geology has not advanced since the time when the discovery was first made public, a period of five-and-twenty years.

Sir Charles Lyell says regarding this deposit:<sup>1</sup> "The late Edward Forbes observed that some of the plants of this formation resembled those of Croatia, described by Unger, and his opinion has been confirmed by Professor Heer, who found that the Conifer most prevalent was the *Sequoia Langsdorfi* (fig. 153, p. 213), also *Corylus grosse-dentata*, a Lower Miocene species of Switzerland and of Menat in Auvergne. There is likewise a plane-tree, the leaves of which seem to agree with those of *Platanus aceroides* (fig. 141, p. 196), and a fern which is as yet peculiar to Mull—*Filicites Hebridicus*, Forbes."

There is also in the Hunterian Museum a leaf from Mull that evidently belongs to a species of *Cinnamomum*.

### LIST OF THE ARDTUN FOSSILS.

- Alanites ? MacQuarrii, *E. Forbes.*
- Cinnamomum, sp.
- Corylus grosse-dentata.
- Equisetum Campbells, *E. Forbes.*
- Filicites ? Hebridicus, *E. Forbes.*
- Platanites Hebridicus and var., *E. Forbes.*
- aceroides.
- Rhamnites lanceolatus, *E. Forbes.*
- major, *E. Forbes.*
- multinervatus, *E. Forbes.*
- Sequoia Langsdorfi.
- Taxites Campbells, *E. Forbes.*

<sup>1</sup> *Student's Elements of Geology*, 1871, p. 223.

## THE FOSSILIFEROUS POST-TERTIARY DEPOSITS CHIEFLY OF THE WEST OF SCOTLAND.

*Preglacial.*—In the West of Scotland we have nothing that can be satisfactorily referred to the Tertiaries or preglacial deposits. On the east coast Mr. Jamieson records the presence of shells in the parishes of Slains and Cruden that leave little doubt of their preglacial character, such as *Voluta Lamberti*, *Cyprina rustica*, *Fusus contrarius*, &c. The position of the sand and gravel containing these shells led to the same conclusion. And there are not wanting reasons for believing that the mammalian remains found under the boulder-clays may mostly, if not all, have had a preglacial existence.

*Glacial.*—That which is commonly termed “boulder-clay” or “till” is widely spread over the low-lying districts of Scotland, but in some cases it reaches considerable elevations. In the low districts it often attains a great thickness, and is well represented in the neighbourhood of Glasgow. This clay in most cases is readily known by its hard, compact, stony, and unstratified character. To this absence of stratification, however, there are some exceptions, but even in these it is more a difference of colour than of materials in the order of arrangement. Where these bands do occur in the boulder-clay they are mostly of considerable thickness, overlying each other and wanting the thin intercalated layers of sand or other material between the deeper alternating layers, so constant in the true laminated clays. Good examples of these bands in the boulder-clay were well seen in a cutting on the north side of the new bridge over the Kelvin near the Botanic Gardens, and at Possil Quarry, and in a section of the railway now in progress east of Falside near Uddingstone. Besides these bands of differently-coloured clays there are often irregular layers of stones promiscuously grouped together.

As a rule the true boulder-clay in Scotland is void of animal remains. Yet in some cases, shells and other organisms are occasionally met with in these clays, as in the cliffs at Wick and in a pit (No. 13) at East Woodhill, Kilmaurs, where fragments of *Astarte sulcata* were found 42 feet from the surface and 28 from the bottom; but these appeared to be derivative, being generally fragmentary and water-worn, and scattered promiscuously throughout the deposit, not in zones as they mostly occur in the laminated shell-bearing clays that overlie the boulder-clay. The worn condition of some of

the remains of the mammals found in these clays may be viewed as an indication of a similar origin.

The boulders obtained in these clays generally amount to about 45 per cent. of the whole mass, and range in size from small gravel to blocks several tons in weight. Some of them are rounded, polished, and striated, the striations generally running in the line of the longer axis of the stone. Many of the blocks have been derived from rocks at great distances, but the greater proportion are of more local origin, and are less rounded or scratched, while others are quit rough and angular.

The *Post-Tertiary* laminated shell-bearing clays of Scotland, with few exceptions, overlie the hard characteristic boulder-clay. They are made up of layers of varied thickness, frequently interstratified with thin beddings of sand, and sparsely interspersed with stones of varied sizes, on which frequently are found the remains of Balani, Serpulae, and Polyzoa. These clays generally contain about 90 per cent. of fine ooze.

Perhaps there is no other district in Scotland where the Post-Tertiary shell-bearing clays prevail with more persistence, or where the fossils are in better condition, than on both sides of the valley of the Clyde from Glasgow to the shores of Bute, where the late Mr. James Smith of Jordanhill made his famous discovery of the arctic character of these deposits. Their main features may at any time be seen to great advantage in the numerous brickworks in the neighbourhood of Paisley. In the valley of the Clyde the shell-bearing beds occur at various elevations. At Paisley Brickfields, for example, they are worked at about 20 feet below the present sea-level, while in the streets of Glasgow they are met with 102 feet above it. This, however, is not the limit of the range of these clays that have come under observation in Scotland. At Chapelhall, near Airdrie, they occur at 510 feet above the level of the sea; and at Dryleys Tilework, Montrose, they are worked 60 feet below it. In some cases they underlie the boulder-clay, as at Tangy Glen, Campbeltown, Argyleshire; Kilmaurs, Ayrshire; and Croftamie, Dumbartonshire. There is much doubt entertained regarding these beds, as to whether they may not be preglacial. It may be remarked, however, that the Mollusca and other organisms which they contain agree closely with those in the laminated clays overlying the boulder-clay. Possibly these cases may mark subsequent local extensions of the boulder-clay, unless it be supposed that the latter has slipped or fallen over the laminated clay, which in some cases seems not improbable.

In the invertebrate fauna of these laminated clays there appears to be no decided break indicating alternate changes of temperature, nothing more than may be reasonably accounted for by local causes, till we come to the old raised sea-beaches, where all the characteristic arctic forms, such as *Pecten Islandicus* and *Tellina calcaria*, entirely disappear.

The most notable shell-bearing clays in the Frith of Clyde are those of *Jordanhill Brickworks*, *Dalmuir*, *Old Mains*, *Paisley Brickworks*, *Garvel Park New Docks*, *Garnock*, *Cumbræ*, *Kyles of Bute*, *Kilchattan Tileworks*, *East Tarbert*, *West Tarbert*, *Lochgilp*, and *Tangy Glen*.

On the east coast of Scotland the localities best known are those at *Elie*, *Errol*, *Barrie*, and *Dryleys*.

There are many other shell-bearing clays of less note overlying the boulder-clay of the West of Scotland, viz. *Muirhouse Brickwork*, *Glasgow*; *Paisley Canal side*, near *Glasgow*; *Windmillcroft Docks*, *Glasgow*; *Stobcross Railway Cutting*, *Glasgow*; *Arkleston Railway Cutting*, near *Paisley*; *Langbank*, between tide-marks; *Gourock*; *Fairlie*, near *Largs*; *Dumbarton*; *Inch Lonaig*, *Lochlomond*; *Rothesay*; *Etterick Bay*, between tide-marks; *Crinan Canal side*; *Duntroon*, near *Duntroon Castle*, west side; *Fort William*; *Dipple Tileworks*, near *Girvan*; *Terral Tileworks*, *Wigtonshire*, 14 miles from *Stranraer*; *Lochaber*, *Inverness-shire*; *Houston Tile Work*, near *Paisley*, &c. &c.

The following list of Post-Tertiary fossils is confined, with few exceptions, to the laminated clays overlying the boulder-clay, omitting those doubtful gatherings procured between tide-marks where in most cases there can be no certainty whether they are Post-Tertiary remains or the dead organisms of the present shore. For the same reason most of the superficial silt and sand beds are also excluded, their position being in many cases doubtful, and requiring greater detail than these lists will admit of, the object being to give only a general index to the more notable shell-bearing clays and their fossil contents in the Frith of Clyde and the West of Scotland.

In preparing the list of species the localities are generally only given where the species prevail most.

## NOTES ON LOCALITIES.

### JORDANHILL BRICKWORKS.

Situated fully a mile to the north-west of *Partick*, and extending on both sides of the *Crow Road* 63 feet above the sea-level. These clays are doubtless extensions or patches of the *Clyde beds*, with a similar fauna. The clay on the north side of the road, where it rises on the incline, is thinner, and contains more shells than on the south side, where the clay is deeper. Its fossils are chiefly characterized by the occurrence of the common mussel, *Mytilus edulis*.<sup>1</sup>

### DALMUIR.

Banks of the *Dalmuir Burn*, about  $8\frac{1}{2}$  miles from *Glasgow*, on the *Dumbarton Road*. The shell-bed occurs at two points—the one on the north side

<sup>1</sup> Robertson and Crosskey, *Trans. Geol. Soc. Glasgow*, iv. p. 141.

of the canal aqueduct, a short distance up on the north side of the Dalmuir Old Paper Mill Dam; the other is north of the bridge on the Dumbarton Road, about half-way up the adjoining field on the east bank of the stream, but as the exposure is very limited it requires some care to find it. The deposit is remarkable for the abundance of small spiral shells. The genus *Trophon* is well represented, *T. truncatus* being unusually common.<sup>1</sup>

#### OLD MAINS, NEAR RENFREW.

In a cutting for a tramway between the Houston pit No. 5 and the Farm Portnault, which had by mistake in former reports been called *Old Mains*. The deposit is made up of loose brown sandy earth. The shells are not in the best state of preservation, being more or less eroded; the rather rare shell *Mölleria costulata* occurs moderately common, and it is the only locality in the Clyde beds where the Actinozoon *Sphenotrochus Wrightii* has been found.<sup>2</sup>

#### ARKLIESTON, NEAR PAISLEY.

A bed containing arctic shells was exposed here during alterations on the north bank of the railway at the west end of the tunnel on Arklieston Farm. The shell-bed rested in a hollow or gully abutting on the rock of the tunnel on the east, and flanking the boulder-clay on the west, and covered at this point by a foot or two of sandy mud. A remarkable feature in this deposit is that it evidently contains a littoral and a deeper-water fauna, which we may reasonably assume obtains in other similarly-situated deposits formed as the water receded from higher to lower levels.<sup>3</sup>

#### PAISLEY.

The shell-bearing laminated clays underlie the whole plain round Paisley, and are well exposed in the numerous brick and tile works of the district. Although the fauna of the clays may differ at different points in paucity or abundance, in diversity of species or state of preservation, yet the examination of it in most cases at any one place may be considered a fair representation of the whole. Good sections may be seen at all times close to the town of Paisley, particularly at Short Road Brickworks.<sup>4</sup>

#### GARVEL PARK, CARTSDYKE, NEAR GREENOCK.

The fossiliferous laminated clay was exposed in a hollow or trough of boulder-clay during the excavation of the Garvel Park New Docks. This deposit is remarkable for the great abundance of organisms crowded within its narrow limits, particularly in regard to the Polyzoa, which exceed in species all those found in the other beds of the valley of the Clyde, and some of the forms are of great rarity.

<sup>1</sup> Crosskey and Robertson, *Trans. Geol. Soc. Glasgow*, ii. p. 270.

<sup>2</sup> *Ib.*, iii. p. 331.

<sup>3</sup> D. Robertson, F.G.S. Paper read before the Geological Society of Glasgow, April, 1876.

<sup>4</sup> Crosskey and Robertson, *Trans. Geol. Soc. Glasgow*, iii. p. 334.



## COLLEGE DEPOSIT, MILLPORT, CUMBRAE, BUTESHIRE.

During the sinking for a water-tank a bed of sand was exposed containing arctic shells. The excavation was made on the east side of the road, a little north of the College Gate. The cutting is now built up. Shells, Echini plates and spines were large and abundant.<sup>1</sup>

## KYLES OF BUTE.

Beds containing arctic shells occur at many points in the Kyles of Bute. Many of the patches of clays exposed along the shores of the Kyles, that formerly yielded abundance of fossils, are now nearly all washed away by the storms and tides. In Balnakille Bay, a little to the west, nearly opposite Colintrave, the shells are exposed in the bank of a stream, where they may be dug out quite free from the debris thrown up by the tide. Specimens of the large *Saxicava* (*Panopæa*) *Norvegica* are not uncommon in this locality.<sup>2</sup>

## KILCHATTAN TILEWORKS, BUTE, at the north-west side of Kilchattan Bay.

The shells in this deposit occur in a stratum of muddy sand overlying a gray laminated clay, in which only a few Foraminifera have been detected. The prevailing shells are *Tellina calcaria*, *Axinus flexuosus*, *Scrobicularia prismatica*, *Cyprina Islandica*, *Mya truncata*, and *Utriculus obtusus*, and are abundant from the fry up to the adult forms.<sup>3</sup>

## LUCKNOW PIT, ARDEER IRONWORKS, STEVENSTON, AYESHIRE.

Here there has either been a bed containing a mixture of arctic and more temperate species, or two beds, the one resting upon the other. Unfortunately this had not been ascertained during the sinking of the pit. The most notable shell from this locality is *Leda Arctica*, but the majority of the shells are such as are found in our raised beaches, which must be taken into account in drawing conclusions from the list.<sup>4</sup>

## GARNOCK WATER.

A shell-bed on the south bank of the Garnock, a little to the south-east of Kilwinning Ironworks, about 6 feet above the level of the stream, and from 10 to 12 inches in thickness. It is composed of muddy sand, so loose that the shells can be readily washed from it.

This layer containing the shells overlies the boulder-clay, and is itself overlaid by about 12 feet of stratified sand and gravel. The shells are well represented and in good condition; amongst them the rather rare *Velutina undata* is moderately common. *Trochus tumidus* is in fine condition and common.<sup>5</sup>

<sup>1</sup> Crosskey and Robertson, *Trans. Geol. Soc. Glasgow*, iii. p. 113.

<sup>2</sup> *Ib.*, v. p. 29.

<sup>3</sup> *Ib.*, iv. p. 128. This section has been also described by Mr. Jamieson, *Quart. Journ. Geol. Soc.* vol. xxi.; by Prof. Geikie, *Trans. Geol. Soc. Glasgow*, vol. i.; and by Mr. James Coult in the *Proceedings of the Nat. Hist. Soc. of Glasgow*, vol. ii.

<sup>4</sup> Crosskey and Robertson, *Trans. Geol. Soc. Glasgow*, iii. p. 127.

<sup>5</sup> D. Robertson, F.G.S. Paper read before the Geol. Soc. of Glasgow, 9th March, 1876.

## WOODHILL QUARRY, KILMAURS, NEAR KILMARNOCK.

A thin bed of sand containing arctic shells occurs here, overlaid by about 50 feet of boulder-clay, and overlying a thin bed of sandy peaty clay, containing numerous seeds of different fresh-water plants. The most notable point is the occurrence of the remains of the mammoth and reindeer in the peaty bed. From time to time some nine or ten tusks and a portion of a molar tooth of the former have been found, along with horns of the latter. Two of the mammoth tusks and the horns of the reindeer are in the Hunterian Museum, Glasgow University.<sup>1</sup>

## EAST TARBERT, LOCH FYNE.

A clay bed is exposed at the north corner of Loch Tarbert, in a small stream called Blackburn, which can be traced from 12 to 15 feet above high-water mark. The organic remains are not numerous, but one or two species are found in fine condition, viz. *Trochus helicinus* and *Axinus flexuosus*.<sup>2</sup>

## WEST TARBERT, LOCH FYNE.

The shell-bed crops out a little beyond where the new road begins, near the head of the loch, on the south side. Some very large and fine specimens of *Natica affinis* have been found in this deposit.<sup>3</sup>

## LOCHGILF, ARGYLSHIRE.

The shell-bearing clay is exposed on the banks of the stream about 20 yards below the bridge crossing the Crinan road to Lochgilphead, and may be traced reappearing at several points from 5 to 10 feet below the surface for some distance above Baden Farm. The first patch exposed above the bridge (about 200 yards distance) is notable for the occurrence in considerable numbers of *Mya Uddevallensis* in their natural position.<sup>4</sup>

## CRINAN.

The shell-bearing bed is exposed on a small plateau by a cutting made to lead off the water from the high level of the Crinan Canal at the north side of lock No. 11. The height of the bed above sea-level is 30 feet. The shells are few and fragmentary, and confined to a very thin layer.<sup>5</sup>

## DUNTRON, ARGYLSHIRE.

A little to the south of Duntroun Castle a shell-bearing clay comes to the surface at high-water mark. The invertebrate fauna is well represented in this deposit both in the larger and smaller forms.<sup>6</sup>

## TANGY GLEN.

This section occurs about 6 miles from Campbeltown, on the Tarbert Road, a few hundred yards up the stream, at a point where it turns east-

<sup>1</sup> A. Geikie, *Glacial Drift of Scotland*, p. 71; J. Bryce, M.A., LL.D., F.G.S., *Quart. Journ. Geol. Soc.*, xxi. p. 218; John Young, F.G.S., and R. Craig, *Trans. Geol. Soc. Glasgow*, iii. p. 810.

<sup>2</sup> Crosskey and Robertson, *Trans. Geol. Soc. Glasgow*, iii. p. 821.

<sup>3</sup> *Ib.*, iii. p. 324.

<sup>4</sup> *Ib.*, iii. p. 118.

<sup>5</sup> *Ib.*, iii. p. 328.

<sup>6</sup> *Ib.*, iii. p. 327.

ward, and about 130 feet above the level of the sea. Here, contrary to the usual position of shell-bearing clay in the West of Scotland, it *underlies* the boulder-clay. The shells are few and of arctic types, among them *Pecten Grœnlandicus*, and resembling more those on the east than on the west of Scotland. This holds good also in regard to the Ostracoda, which, together with the Foraminifera, are more numerously represented than the shells.<sup>1</sup>

It may be mentioned that a few of the localities given in the list, such as the "Clyde beds," "Bute," &c., though inserted on the authority of eminent naturalists, are somewhat indefinite in their character; and as we know that many of the early gatherings were obtained from Post-Tertiary deposits where they are most liable to be mixed with recent organic remains, these are not fully to be depended upon as evidence of arctic conditions.

## CATALOGUE OF SCOTTISH POST-TERTIARY FOSSILS.

### PLANTÆ.—ALGÆ.

MELOBESIA, *Linné.*

polymorpha, *Linn.*

Caithness, in boulder-clay; Dalmuir; West Tarbert; Garvel Park.

CORALLINA, *Linné.*

officinalis, *Linn.*

Paisley.

JANIA, *Lamouroux.*

rubens, *Lamour.*

Paisley.

### PORIFERA.

#### Spongidæ.

CLIONA, *Grant.*

celata, *Grant.*

Caithness, in boulder-clay; Lochgilp; Old Mains; Paisley; Garvel Park; Kilchattan.

GEODIA, *Lamarck.*

sp.

Caithness (C. W. Peach).

### SUB-KINGDOM PROTOZOA.—FORAMINIFERA.

#### Sub-order Imperforata.

#### FAMILY MILIOLIDA.

CORNUSPIRA, *D'Orbigny.*

foliacea, *Phil.*

Garvel Park; Garnock Water; E. Tarbert; Lochgilp; Tangy Glen.

<sup>1</sup> Robertson and Crosskey, *Trans. Geol. Soc. Glasgow*, iv. p. 134.

**BILOCULINA, D'Orbigny.***ringens, Lam.*

Jordanhill; Old Mains; Paisley; Kilchattan; Lochgilp; Tangy Glen.

*depressa, D'Orb.*

Jordanhill; Garnock Water; Kyles of Bute.

*elongata, D'Orb.*

Jordanhill; Dalmuir; Tangy Glen.

**TRILOCULINA, D'Orbigny.***trigonula, Lam.*

Garnock Water.

*oblonga, Mont.*

Garvel Park; Garnock Water; Kyles of Bute; Lochgilp.

*Brongniartii, D'Orb.*

Garnock Water.

**QUINQUELOCULINA, D'Orbigny.***seminulum, Linn.*

Jordanhill; Dalmuir; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; Paisley; E. and W. Tarbert; Tangy Glen.

*subrotunda, Mont.*

Jordanhill; Dalmuir; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kilchattan; East Tarbert; Lochgilp; Tangy Glen.

*bicornis, W. & J.*

Garnock Water.

*agglutinans, D'Orb.*

Paisley; Garvel Park; Kyles of Bute.

**SPIROLOCULINA, D'Orbigny.***planulata, Lam.*

Dalmuir.

**FAMILY LITUOLIDA.****LITUOLA, Lamarck.***scorpiurus, Montf.*

Paisley; Kilchattan.

**Sub-order Perforata.****FAMILY LAGENIDA.****LAGENA, Walker.***sulcata, W. & J.*

Garvel Park; Garnock Water; Kyles of Bute; East Tarbert; Lochgilp; Tangy Glen.

*lævis, Mont.*

Paisley; Garvel Park; Cumbræ Coll.; Kyles of Bute; Kilchattan; West Tarbert; Tangy Glen.

*gracillima, Seg.*

Garvel Park; Tangy Glen.

*globosa, Mont.*

Jordanhill; Dalmuir; Paisley; Garvel Park; Cumbræ Coll.; Kyles of Bute; Kilchattan; E. Tarbert; Tangy Glen.

*LAGENA—continued.**striata, D'Orb.*

Paisley; Garvel Park; Kyles of Bute; Kilchattan; W. Tarbert; Lochgilp.

*semistriata, Will.*

Kyles of Bute; W. Tarbert; Lochgilp.

*apiculata, Reuss.*

Kyles of Bute.

*distoma, P. & J.*

Paisley; Garvel Park; Kyles of Bute; Kilchattan; W. Tarbert; Lochgilp.

*caudata, D'Orb.*

Garnock Water; West Tarbert.

*marginata, Mont.*

Paisley; Garnock Water; Cumbræ Coll.; Kilchattan; Tangy Glen.

*ornata, Will.*

Lochgilp.

*squamosa, Mont.*

Kyles of Bute; Lochgilp; Tangy Glen.

*Jeffreysii, Brady.*

E. Tarbert; Tangy Glen.

*DENTALINA, D'Orbigny.**communis, D'Orb.*

Garvel Park; Cumbræ Coll.; Kyles of Bute; Kilchattan.

*VAGINULINA, D'Orbigny.**legumen, Linn.*

Tangy Glen.

*CRISTELLARIA, Lamarck.**rotulata, Lam.*

Garvel Park; Kyles of Bute; Kilchattan.

*POLYMORPHINA, D'Orbigny.**lactea, W. & J.*

Dalmuir; Garvel Park; Garnock Water; Kyles of Bute; Kilchattan; Lochgilp; Tangy Glen.

*var. communis, D'Orb.*

Cumbræ Coll.

*compressa, D'Orb.*

Dalmuir; Paisley; Garvel Park; E. and W. Tarbert; Tangy Glen.

*oblonga, Brown.*

Garnock Water; Kyles of Bute; E. Tarbert.

*gibba, D'Orb.*

Kyles of Bute; E. Tarbert.

*UVIGERINA, D'Orbigny.**pygmæa, D'Orb.*

Kilchattan; Lochgilp; Tangy Glen.

## FAMILY GLOBIGERINIDA.

*ORBULINA, D'Orbigny.**universa, D'Orb.*

Jordanhill; Garnock Water.

- GLOBIGERINA**, *D'Orbigny*.  
*bulloides*, *D'Orb.*  
 Jordanhill; Dalmuir; Garnock Water; Tangy Glen.
- TEXTULARIA**, *DeFrance*.  
*sagittula*, *DeFr.*  
 Jordanhill; Dalmuir.  
*variabilis*, *Will.*  
 West Tarbert.
- VERNEUILINA**, *D'Orbigny*.  
*polystropha*, *Reuss*.  
 Garvel Park; Kilchattan.
- BULIMINA**, *D'Orbigny*.  
*pupoides*, *D'Orb.*  
 Kilchattan.  
*marginata*, *D'Orb.*  
 Garvel Park; Kyles of Bute; E. and W. Tarbert; Lochgilp.
- BOLIVINA**, *D'Orbigny*.  
*punctata*, *D'Orb.*  
 Garnock Water; West Tarbert.
- CASSIDULINA**, *D'Orbigny*.  
*levigata*, *D'Orb.*  
 Kilchattan; Lochgilp; Tangy Glen.  
*crassa*, *D'Orb.*  
 Cumbræ Coll.; Lochgilp.
- DISCORBINA**, *Parker and Jones*.  
*rosacea*, *D'Orb.*  
 Paisley; Garnock Water; Lochgilp.  
*globularis*, *D'Orb.*  
 Tangy Glen.
- PLANORBULINA**, *D'Orbigny*.  
*Mediterranensis*, *D'Orb.*  
 Garnock Water.
- TRUNCATULINA**, *D'Orbigny*.  
*lobatula*, *Walker*.  
 Dalmuir; Paisley; Garvel Park; Garnock Water; Cumbræ  
 Coll.; Kilchattan; W. Tarbert; Lochgilp; Tangy Glen.
- ROTALIA**, *Lamarck*.  
*Beccarii*, *Linn.*  
 Paisley; Garnock Water; Kyles of Bute; Kilchattan; Tangy  
 Glen.  
*orbicularis*, *D'Orb.*  
 Lochgilp.
- PATELLINA**, *Williamson*.  
*corrugata*, *Will.*  
 Paisley; Garvel Park.

## FAMILY NUMMULINIDÆ.

- POLYSTOMELLA**, *Lamarck*.  
*crispa*, *Linn.*  
 West Tarbert; Lochgilp; Tangy Glen.

POLYSTOMELLA—*continued*.striato-punctata, *F. & M.*

Jordanhill; Dalmuir; Paisley; Garnock Water; Kyles of Bute; Kilchattan; E. and W. Tarbert; Lochgilp; Tangy Glen.

Arctica, *J. & P.*

Kyles of Bute; W. Tarbert.

NONIONINA, *D'Orbigny*.asterizans, *F. & M.*

Tangy Glen; Garnock Water; Cumbræ Coll.; Kyles of Bute.

turgida, *Will.*

Kyles of Bute; Kilchattan; Lochgilp.

depressula, *W. & J.*

Dalmuir; Paisley; Garvel Park; Garnock Water; Kyles of Bute; Kilchattan; Tangy Glen.

## ZOOPHYTA.

SPHENOTROCHUS, *Edwards and Haime*.Wrightii, *Gosse*.

Old Mains.

EUDENDRIUM, *Ehrenberg*.rameum, *Mall.*

Arkliston, near Paisley.

## ECHINODERMATA.

## Ophiuroidea.

OPHIOCOMA, *Agassiz*.ballis, *Link.*

Spines and Plates. Dalmuir; Paisley; Garvel Park.

rosula, *Link.*

Spines. Caithness, in boulder-clay.

OPHIURA, *Lamarck*.albida, *Forbes*.

West Tarbert; Duntroon; Garvel Park; Kilchattan.

texturata, *Lam.*

Garvel Park.

OPHIOLEPIS, *Müller and Troschel*.gracilis, *Allman*.

West Barns Brickfield, 2 miles west of Dunbar, in natural position, embedded in clay.

## Echinoidea.

ECHINUS, *Linné*.Dröbachiensis, *Müller*.

Dalmuir; Cumbræ Coll.; Lochgilp; E. and W. Tarbert; Crinan; Duntroon; Old Mains; Paisley; Garvel Park; Kilchattan.

sphaera, *Müller*.

Lochgilp; Garvel Park; Kilchattan.

neglectus, *Lam.*

Spines. Caithness, in boulder-clay.

**Spatangidae.**

Spines and Plates.

**Holothuroidea.****PSOLUS**, *Oken.**phantapus*, *Linn.*

Houston, near Paisley; Bute (Prof. Geikie).

**SIFUNCULUS**, *Linné.**Bernhardus*, ? *Forbes.*Clay burrows not uncommon in small spiral shells. Dalmuir  
&c.**ANNELIDA.****Tubicola.****FILOGRANA**, *Berkeley.**implexa*, *Berk.*

Garvel Park.

**PECTINARIA**, *Lamarck.**sp.*

Caithness, in boulder-clay (Peach).

**SERPULA**, *Linné.**triquetra*, *Martin.*Dalmuir; Stevenston (Landsborough *vide* Smith); Lochgilp.*vermicularis*, *Ellis.*

Caithness, in boulder-clay, Dalmuir; Lochgilp; W. Tarbert;

Garvel Park; Kilchattan; Jordanhill; Garnock Water.

**SPIROBIS**, *Lamarck.**carinatus*, *Flem.*

Paisley.

*nautiloides*, *Lam.*Dalmuir; Stevenston (Landsborough, *vide* Smith).*corrugatus*, *Mont.*

Bute (Smith).

*granulatus*, *Mont.*

Caithness, in boulder-clay.

*spirillum*, *Linn.*

E. Tarbert; Duntroon; Paisley; Garvel Park; Arran; Jordanhill.

**CRUSTACEA.****Ostracoda.****POTAMOCYPRIS**, *Brady.**fulva*, *Brady.*

Dalmuir.

**ARGILLICOLA**, *G. O. Sars.**cylindrica*, *G. O. Sars.*

Garvel Park; Dalmuir; Paisley; Garnock Water; Kilchattan.

**PONTOCYPRIS**, *G. O. Sars.**mytiloides*, *Norman.*

Garvel Park; Dalmuir; Paisley.

*trigonella*, *G. O. Sars.*

Garvel Park; Paisley; Lochgilp.



*AGLAIA, Brady.**glacialis, B., C., & R.*

Drip Bridge, near Stirling.

*BAIRDIA, M'Coy.**inflata, Norman.*

Raised beach, Oban.

*CYTHÆRE, Müller.**pellucida, Baird.*Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park;  
Cumbrae Coll.; Kyles of Bute; E. and W. Tarbert; Lochgilp.*castanea, G. O. Sars.*Jordanhill; Dalmuir; Old Mains; Paisley; Garnock Water;  
Cumbrae Coll.; Kilchattan; Tangy Glen.*porcellanea, Brady.*Dalmuir; Garvel Park; Garnock Water; Cumbrae Coll.;  
Kilchattan; Lochgilp.*Macallana, Brady and Robertson.*

Cumbrae Coll.; Kilchattan.

*tenera, Brady.*

Garnock Water.

*deflexa, B., C., & R.*

Jordanhill.

*crispata, Brady.*

Paisley.

*viridis, Müller.*Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park;  
Garnock Water; Cumbrae Coll.; Kyles of Bute; Kilchattan;  
E. and W. Tarbert.*lutea, Müller.*Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park;  
Garnock Water; Cumbrae Coll.; Kyles of Bute; Kilchattan;  
E. and W. Tarbert; Tangy Glen.*albo-maculata, Baird.*

Cumbrae Coll.

*convexa, Baird.*

Paisley; Cumbrae Coll.; Lochgilp.

*Clutha, B., C., & R.*

Garvel Park; Kilchattan.

*Finmarchica, G. O. Sars.*

Lochgilp.

*limicola, Norman.*Garvel Park; Cumbrae Coll.; Kyles of Bute; Kilchattan;  
Tangy Glen.*globulifera, Brady.*

Jordanhill; Paisley; Tangy Glen.

*cuneiformis, Brady.*

Bridge of Allan; Raised beach, Oban.

*pulchella, Brady.*Jordanhill; Garnock Water; Cumbrae Coll.; Kilchattan; West  
Tarbert; Lochgilp.

## CYTHERE—continued.

*villosa*, *G. O. Sars.*

Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; West Tarbert; Lochgilp.

*concinna*, *Jones.*

Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; West Tarbert; Lochgilp; Tangy Glen.

*quadridentata*, *Baird.*

Lochgilp.

*angulata*, *G. O. Sars.*

Dalmuir; Old Mains; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; E. and W. Tarbert; Lochgilp.

*tuberculata*, *G. O. Sars.*

Dalmuir; Old Mains; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; E. and W. Tarbert; Lochgilp.

*emarginata*, *G. O. Sars.*

Lag, Arran; E. Tarbert; Errol.

*costata*, *Brady.*

Paisley.

*mirabilis*, *Brady.*

Lochgilp (?); Errol; Barrie; Montrose.

*Dunelmensis*, *Norman.*

Jordanhill; Dalmuir; Old Mains; Paisley; Cumbræ Coll.; Kyles of Bute; Kilchattan; E. and W. Tarbert; Lochgilp; Tangy Glen.

*Robertsoni*, *Brady.*

Lochgilp.

*gibbosa*, *Brady and Robertson.*

Garnock Water.

CYTHERIDEA, *Bosquet.**papillosa*, *Bosq.*

Jordanhill; Old Mains; Paisley; Garvel Park; Garnock Water; Kyles of Bute; Kilchattan; E. and W. Tarbert; Lochgilp; Tangy Glen.

*punctillata*, *Brady.*

Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; West Tarbert; Lochgilp.

*Sorbyana*, *Jones.*

Tangy Glen.

EUCYTHERE, *Brady.**Argus*, *G. O. Sars.*

Dalmuir; Old Mains; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; E. Tarbert; Lochgilp.

*declivia*, *Norman.*

Cumbræ Coll.

- KRITH**, *Brady, Crosskey, and Robertson.*  
*Bartonensis, Jones.*  
 Crinan; Duntroon; Elie.
- LOXOCOONCHA**, *G. O. Sars.*  
*impressa, Baird.*  
 Jordanhill.  
*tamarindus, Jones.*  
 Jordanhill; Dalmuir; Paisley; Garvel Park; Garnock Water;  
 Cumbræ Coll.; Kyles of Bute; Kilchattan; E. and W. Tarbert;  
 Lochgilp.  
*elliptica, Brady.*  
 Govan New Docks.  
*fragilis, G. O. Sars.*  
 Paisley; Garvel Park.
- XESTOLEBERIS**, *G. O. Sars.*  
*depressa, G. O. Sars.*  
 Jordanhill; Paisley; Lochgilp.  
*aurantia, Baird.*  
 Lochgilp.
- CYTHURURA**, *G. O. Sars.*  
*nigrescens, Baird.*  
 Jordanhill; Dalmuir; Old Mains; Garnock Water; Kyles of  
 Bute; Kilchattan; E. and W. Tarbert; Tangy Glen.  
*similis, G. O. Sars.*  
 Dalmuir; Garvel Park; Cumbræ Coll.; Kyles of Bute; Kil-  
 chattan; E. Tarbert.  
*pumila, B., C., & R.*  
 Dalmuir; Garvel Park; Cumbræ Coll.  
*concentrica, B., C., & R.*  
 Paisley.  
*complanata, B., C., & R.*  
 Annochie, Aberdeenshire.  
*undata, G. O. Sars.*  
 Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park; Gar-  
 nock Water; Cumbræ Coll.; Kyles of Bute; Kilchattan; E. and  
 W. Tarbert; Tangy Glen.  
*striata, G. O. Sars.*  
 Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute;  
 Kilchattan; West Tarbert.  
*Sarsi, Brady.*  
 Dalmuir; Paisley; Garvel Park; Garnock Water; Cumbræ  
 Coll.; Kyles of Bute; Kilchattan; E. Tarbert.  
*gibba, Müller.*  
 Jordanhill; Kilchattan.  
*flavescens, Brady.*  
 Kyles of Bute.  
*cellulosa, Norman.*  
 Jordanhill.  
*clathrata, G. O. Sars.*  
 Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park; Gar-  
 nock Water; Cumbræ Coll.; E. Tarbert; Tangy Glen.

**CYTHERRURA**—*continued*.*cornuta*, *Brady*.

Garnock Water.

**CYTHEROPTERON**, *G. O. Sars*.*latissimum*, *Norman*.

Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park; Cumbræ Coll.; Kyles of Bute; Kilchattan; E. and W. Tarbert; Tangy Glen.

*nodosum*, *Brady*.

Jordanhill; Dalmuir; Garvel Park; Cumbræ Coll.

*arcuatum*, *B., C., & R.*

Tangy Glen.

*Montrosiense*, *B., C., & R.*

Tangy Glen.

*angulatum*, *B. & R.*

Dalmuir; Garvel Park; Cumbræ Coll.; Kyles of Bute; West Tarbert.

**BYTHOCYTHERE**, *G. O. Sars*.*simplex*, *Norman*.

Jordanhill; Dalmuir; Paisley; Garvel Park; West Tarbert.

*constricta*, *G. O. Sars*.

Tangy Glen.

*elongata*, *B., C., & R.*

Govan New Dock.

**PSEUDOCYTHERE**, *G. O. Sars*.*caudata*, *G. O. Sars*.

Dalmuir; E. Tarbert.

**CYTHERRIDEIS**, *Jones*.*subspiralis*, *B., C., & R.*

Wick.

**SCLEROCHILUS**, *G. O. Sars*.*contortus*, *Norman*.

Jordanhill; Dalmuir; Old Mains; Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; E. and W. Tarbert.

**PARADOXOSTOMA**, *Fischer*.*variable*, *Baird*.

Paisley; Garvel Park; Garnock Water; Cumbræ Coll.; Kyles of Bute; East Tarbert; Tangy Glen.

*abbreviatum*, *G. O. Sars*.

Lochgillp.

*ensifforme*, *Brady*.

Garnock Water; Kyles of Bute.

*Fischeri*, *G. O. Sars*.

Garvel Park; Garnock Water.

*flexuosum*, *Brady*.

Lochgillp.

*tenerum*, *B., C., & R.*

Dalmuir; Garvel Park.

**ASTEROPE**, *Philippi*.*teres*, *Norman*.

Jordanhill.

**POLYCOPE, *G. O. Sars.***orbicularis, *G. O. Sars.*

Dalmuir; Old Mains; Paisley; Garvel Park.

**BOSQUETIA, *Brady, Crosskey, & Robertson.***robusta, *B., C., & R.*

Paisley.

**Cirripedia.****BALANUS, *Lister.***balanoides, *Linn.*

Paisley; Windmillcroft; Dalmuir (Smith); Jordanhill.

crenatus, *Brug.*

Caithness, in boulder-clay; Dalmuir; Paisley; Cumbrae Coll.;

E. and W. Tarbert; Old Mains; Crinan; Garvel Park; Duntroon;

Kilchattan; Jordanhill; Kyles of Bute; Garnock Water.

concavus, *Bronn.*

Aberdeenshire (Jamieson).

Hameri, *Ascanius.*

Lochgill; Old Mains; Garvel Park.

porcatus, *Da Costa.*

Caithness, in boulder-clay; Elie; Errol; Dalmuir; Cumbrae

Coll.; Lochgill; West Tarbert; Crinan; Old Mains; Duntroon;

Paisley; Garvel Park; Kilchattan; Kyles of Bute; Jordanhill;

Garnock Water.

cariosus, *Darwin.*

Kyles of Bute.

**VERRUCA, *Schumacher.***Strömia, *Müller.*

Caithness, in boulder-clay; Dalmuir; Cumbrae Coll.; Lochgill;

W. Tarbert; Crinan; Duntroon; Old Mains; Paisley; Garvel

Park; Kilchattan; Tangy Glen.

**POLYZOA.**

Polyzoa are found in the shelly clays both on the east and west of Scotland, but only in a few localities are they abundant either in species or individuals. Those from Garvel Park New Docks near Greenock far exceed in profusion and number of species what have been recorded from any other of our Post-Tertiary deposits. Here *Idmonea Atlantica* is very common and in fine condition. The only other Scottish deposit where this species has been met with is on the opposite side of the Firth of Clyde a little to the east of Helensburgh, and is probably an outlier of the same bed.

Since the publication of the paper on Garvel Park in the *Transactions of the Geological Society of Glasgow* in 1874 the number of species of Polyzoa from that locality has been nearly doubled.

In the preparation of this list of Polyzoa we are greatly indebted to the Rev. A. M. Norman for his valuable assistance.

**Cellulariæ.****CELLULARIA, *Pallas.***Peachii, *Busk.*

Garvel Park.

**CELLULARIA—continued.**reptans, *Linn.*

Duntroon; Paisley.

**MENIPEA, Lamouroux.**ternata, var. *Ellis & Sol.*

Garvel Park.

**SCRUPOCELLARIA, Van Ben.**scruposa, *Linn.*

Caithness.

scabra, *Van. Ben.*, var. *elongata, Smitt.*

Garvel Park.

**Scrupariadæ.****HIPPOTHOA, Lamouroux.**divaricata, *Lam.*

Caithness, in boulder-clay.

catenularia, *Jamieson.*

Dalmuir; Duntroon.

**Cabereadæ.****CABEREA, Lamouroux.**Ellisii, *Fleming.*

Garvel Park.

**Bicellariadæ.****BUGULA, Oken.**avicularia, *Pallas.*

Duntroon.

**Membraniporidæ.****MEMBRANIPORA, Blainville.**Flemingii, *Busk.*

Garvel Park; Lochgilp.

tuberculata, *Busk.*

Garvel Park.

unicornis, *Blainville*, sp. ?

Paisley; Dalmuir; Duntroon.

craticula, *Alder.*

Paisley.

**LEPRALIA, Johnston.**Peachii, *Johnston.*

Cumbrae College; Caithness, in boulder-clay.

var. *labiosa, Busk.*

Caithness, in boulder-clay.

concinna, *Busk.*

Garvel Park; Lochgilp.

annulata, *Fabr.*

Garvel Park.

hyalina, *Linn.*

Garvel Park.

verrucosa, *Esper.*

Dalmuir; Duntroon; Garvel Park.

LEPRALIA—*continued.*

- crystallina, *Norman*.  
Garvel Park.  
spinifera, *Johnston*.  
Dalnuir.  
cruenta, *Norman*.  
Garvel Park.  
tubulosa, *Norman*.  
Garvel Park.  
divisa, ? *Norman*.  
Dalnuir.  
simplex, *Johnston*.  
Caithness, in boulder-clay.  
pertusa, *Esper*.  
Dalnuir.

## Celleporidae.

- CELLEPORA, *Fabricius*.  
pumicosa, *Linn*.  
Caithness, in boulder-clay.

## Escharidae.

- ESCHARA, *Ray*.  
patens, *Smitt*.  
Garvel Park.  
struma, *Norman*.  
Garvel Park.  
ESCHAROIDES, *Smitt*.  
Sarsi, *Smitt*.  
Garvel Park.

## Crisidae.

- CRISIA, *Lamouroux*.  
eburnea, *Linn*.  
Dalnuir; Lochgilp; Crinan; Duntroon; Paisley; Garvel Park  
Kilchattan; Tangy Glen.  
denticulata, *Lam*.  
Caithness, in boulder-clay.

## Idmoneidae.

- IDMONEA, *Lamouroux*.  
Atlantica, *Forbes*.  
Garvel Park.

## Tubuliporidae.

- TUBULIPORA, *Lamarck*.  
flabellaris, *Fabr*.  
Dalnuir.  
phalangea, *Couch*.  
Dalnuir; Duntroon; Garvel Park.  
serpens, *Linn*.  
Dalnuir; Garvel Park.

**Diastoporidae. ;**

**DIASTOPORA**, *Lamouroux.*  
*obelia*, *Flem.*  
 Garvel Park.

**Discoporellidae.**

**DISCOPORELLA**, *Gray.*  
*hispidia*, *Fleming.*  
*Paisley.*  
*Grignoniensis*, *Busk.*  
 Dalmuir; Duntroon.  
*flosculus*, *Hincks.*  
 Garvel Park.  
*radiata*, *Busk.*  
 Garvel Park.

**MOLLUSCA.****Brachiopoda.**

The Brachiopoda have been but rarely met with in the Post-Tertiary clays in the West of Scotland, and their discovery has been confined to the industry of our earlier pioneers James Smith of Jordanhill and Edward Forbes, and on the east coast by C. W. Peach.

**RHYNCHONELLA**, *Fischer.*  
*psittacea*, *Chemn.*

Ayrshire (Forbes); Caithness (Peach).<sup>1</sup>

**TREBRATULA**, *Lhwyd.*  
*caput-serpentis*, *Linn.*  
 Ayrshire (Smith).<sup>2</sup>

**Conchifera.****FAMILY ANOMIIDÆ.**

**ANOMIA**, *Linné.*  
*ephippium*, *Linn.*

Common in most of the Post-Tertiary clays in the West of Scotland, but seldom of large size.

*ephippium*, *var. aculeata*, *Linn.*  
 Kilchattan; Garvel Park; Dalmuir; Paisley; Cumbrae Coll.;  
 Lochgilp; Kyles of Bute.  
*ephippium*, *var. squamula*, *Linn.*  
 Garvel Park; Paisley; Lochgilp.  
*patelliformis*, *Linn.*  
 Stevenston.

**FAMILY OSTREIDÆ.**

**OSTREA**, *Linné.*  
*edulis*, *Linn.*

Caithness (Peach). A doubtful species in beds containing arctic shells, in the West of Scotland; but not uncommon in the old silts and raised beaches.

<sup>1</sup> *Mem. Geol. Surv.* vol. i. p. 406.

<sup>2</sup> *Researches*, p. 55.



## FAMILY PECTENIDÆ.

*PECTEN*, *Pliny*.*Islandicus*, *Müll.*

Belhelvie and Ellishill on the east coast, and generally common in the laminated clays on the west coast. Perhaps the most remarkable and suggestive occurrence of this species in the West of Scotland is that of being met with at Kilmaurs under 40 feet of boulder-clay.<sup>1</sup>

*Groenlandicus*, *Lam.*

Errol, Elie, and Montrose on the east coast in laminated clay, and Tangy Glen, near Campbeltown, on the west coast; in this deposit it underlies the boulder-clay.

*maximus*, *Linn.*

Garvel Park, near Greenock; very rare in the laminated clays containing arctic shells.

*opercularis*, *Linn.*

Caithness, in boulder-clay; Lucknow Pit, Stenvenston; Kyles of Bute (Prof. Geikie); Arran (Bryce); Cruden (Jamieson).

*pusio*, *Linn.*

Dalmuir (Smith).

*septemradiatus*, *Müll.*

Loch Lomond beds (Smith).

*varius*, *Linn.*

Dalmuir.

*similis*, *Laskey*.

Fifeshire (Fleming *vide* Smith).

*tigrinus*, *Müll.*

Loch Lomond (Smith).

## FAMILY MYTILIDÆ.

*MYTILUS*, *Linné*.*edulis*, *Linn.*

Not uncommon in the Post-Tertiary clays.

*modiolus*, *Linn.*

Dalmuir; Garvel Park; West Tarbert; Crinan; Old Mains; Paisley; Cumbræ Coll.; Lochgilp; Kilchattan; Kyles of Bute; Garnock Water.

*MODIOLARIA*, *Beck*.*discors*, *Linn.*

Paisley, rare, *fry*.

*discors*, *var. lævigata*, *Gray*.

Dalmuir; Lochgilp; Elie and Errol on east coast.

*nigra*, *Gray*.

Garvel Park; Kyles of Bute.

*CRENELLA*, *Brown*.*decussata*, *Mont.*

Caithness, in boulder-clay.

*faba*, *Müll.*

Errol (Jamieson).

<sup>1</sup> Young and Craig, *Trans. Geol. Soc. Glasgow*, vol. iii, p. 310.

## FAMILY ARCIDÆ.

NUCULA, *Lamarck.**nitida*, *G. B. Sow.*

Paisley.

*tenuis*, *Mont.*

Jordanhill; Garvel Park; West Tarbert; Duntroon; Paisley;

Lochgill; Kilchattan.

*tenuis*, *var. expansa*, *Reeve.*

College deposit; Cumbrae.

*tenuis*, *var. inflata*, *Mörch.*

Paisley.

*nucleus*, *Linn.*

Paisley; Lochgill.

*nucleus*, *var. tumidula*, *Malm.*

Paisley; rare.

*nucleus*, *var. radiata.*

Garvel Park.

LEDA, *Schumacher.**pernula*, *Müll.*Duntroon; Jordanhill; Garvel Park; Dalmuir; Crinan; Old  
Mains; Paisley; Lochgill; Kilchattan; Kyles of Bute; Garnock  
Water; Kilmaurs.*pernula*, *var. mucilenta*, *Steenst.*

Garvel Park; Paisley; Kilchattan.

*pernula*, *var. baccata*, *Steenst.*

Caithness, in boulder-clay.

*pygmæa*, *Münst.*Dalmuir; Jordanhill; West Tarbert; Crinan; Duntroon; Old  
Mains; Paisley; Cumbrae Coll.; Lochgill; Kyles of Bute; Gar-  
nock Water; Windmillcroft; and on the east coast, Montrose,  
Annochie, Elie, and Errol.*pygmæa*, *var. gibbosa*, *Smith.*

Cumbrae College.

*pygmæa*, *var. lenticula*, *Müll.*

Garvel Park; Paisley; Kilchattan.

*Arctica*, *Gray.*Elie, Errol, Montrose, on the east coast; on the west, at  
Lucknow Pit, Stevenston; Clashmahew Tileworks, near Stranraer.*limata*, *Say.*

King Edward (Jamieson).

*lucida*, *Lovén.*

King Edward (Jamieson).

*minuta*, *Müll.*

Caithness, in boulder-clay; Elie; Errol; Bute.

## FAMILY KELLIDÆ.

LEPTON, *Turton.**nitidum*, *Turt.*

Lochgill.

MONTACUTA, *Turton*.bidentata, *Mont.*

Dalmuir.

elevata, *Stimp.*

Lochgilp; Tangy Glen.

ferruginosa, *Mont.*

Kilchattan Tilework.

## FAMILY LUCINIDÆ.

LUCINA, *Bruguière*.borealis, *Linn.*

Caithness, in boulder-clay; Kyles of Bute; Gourock. It is very doubtful that these from the Frith of Clyde are post-glacial.

spinifera, *Mont.*

Caithness, in boulder-clay.

AXINUS, *Sowerby*.flexuosus, *Mont.*

Dalmuir; E. and W. Tarbert; Crinan; Duntroon; Paisley; Cumbræ Coll.; Lochgilp; Garnock Water.

flexuosus, var. *Gouldii*, *Phil.*

Paisley; Lochgilp; Garvel Park; Kilchattan; Kyles of Bute.

flexuosus, var. *Sarsii*, *Phil.*

Annochie (Jamieson).

ferruginosus, *Forbes*.

Annochie.

## FAMILY CARDITIDÆ.

CYAMUM, *Philippi*.minutum, *Fabr.*

West Tarbert.

## FAMILY CARDIADÆ.

CARDIUM, *Linn.*Norvegicum, *Spengler*.

Caithness, in boulder-clay; Cruden; Stevenston (Landsborough); Lucknow Pit; College, Cumbræ.

fasciatum, *Mont.*

Garvel Park; West Tarbert; Paisley; Cumbræ Coll.; Lochgilp; Kyles of Bute; Arran; Caithness, in boulder-clay.

exiguum, *Gmelin*.

Dalmuir; Garvel Park; Bute (Smith); Caithness, in boulder-clay.

edule, *Linn.*

Dalmuir; Old Mains; Lochgilp; Kilchattan; Garnock Water; Paisley; Lucknow Pit; and Caithness, in boulder-clay.

echinatum, *Linn.*

Paisley; Lochgilp; Kilchattan; Lucknow Pit; Stevenston; Gamrie; Belhelvie; Caithness, in boulder-clay.

aculeatum, *Linn.*

Stevenston (Landsborough).

Groenlandicum, *Chemn.*

Gamrie and King Edward (Jamieson).

## FAMILY CYPRINIDÆ.

CYPRINA, *Lamarck*.*Islandica*, *Linn.*

Occurs in nearly all our Post-Tertiary shell-bearing clays.

ASTARTE, *Sowerby*.*sulcata*, *Da Costa*.

Garvel Park; West Tarbert; Old Mains; Paisley; Lochgilp;  
Kyles of Bute; Caithness, in boulder-clay.

*sulcata*, *var. elliptica*, *Brown*.

Dalmuir; Lochgilp; Croftamie; Belhelvie,

*compressa*, *Mont.*

Garvel Park; Dalmuir; West Tarbert; Duntroon; Old Mains;  
Paisley; Lochgilp; Kilchattan; Kyles of Bute; Garnock Water;  
Croftamie; Gamrie; Elie; Caithness, in boulder-clay.

*compressa*, *var. globosa*, *Müll.*

Garvel Park; Paisley.

*compressa*, *var. striata*, *Müll.*

Paisley.

*borealis*, *Chemn.*

Not uncommon in the Clyde beds, and east of Scotland.

*crebricostata*, *Forbes*.

Dalmuir and Bute (Smith).

## FAMILY VENERIDÆ.

VENUS, *Linné*.*ovata*, *Penn.*

Tangy Glen; Caithness, in boulder-clay.

*casina*, *Linn.*

Caithness, in boulder-clay.

*fasciata*, *Da Costa*.

Lucknow Pit.

*exoleta*, *Linn.*

Lucknow Pit; Clyde Beds (Smith).

*gallina*, *Linn.*

Caithness, in boulder-clay.

*lincta*, *Pult.*

Dalmuir; Caithness, in boulder-clay.

TAPES, *Muhlfeldt*.*virgineus*, *Linn.*

Garnock Water; Kyles of Bute (Prof. Geikie).

LUCINOPSIS, *Forbes*.*undata*, *Penn.*

Ayr (Smith); Kyles of Bute (Crosskey).

## FAMILY TELLINIDÆ.

TELLINA, *Linné*.*calcaria*, *Chemn.*

Common in all the characteristic arctic shell-bearing clays  
both on the west and east coasts of Scotland.

*balthica*, *Linn.*

Sparsely met with at Dalmuir, Old Mains, and Paisley  
deposits, and at Gamrie, King Edward, and Belhelvie.

**TELLINA**—*continued.*

- fabula*, *Gron.*  
Lochgilp.
- squalida*, *Pult.*  
Dalmuir; Kyles of Bute; rare.
- Grœnlandica*, *Beck.*  
Bute (Forbes).
- tenuis*, *Da Costa.*  
Gamrie; Kyles of Bute (Crosskey).

**PSAMMOBIA**, *Lamarck.*

- Ferröensis*, *Chemn.*  
Kyles of Bute (Crosskey).

**DONAX**, *Linné.*

- vittatus*, *Da Costa.*  
Caithness, in boulder-clay; Ayr (Smith).

## FAMILY MACTRIDÆ

**MACTRA**, *Linné.*

- solida*, *Linn.*  
Kyles of Bute (Prof. Geikie); Stevenston (Landsborough).
- solida*, *var. elliptica*, *Brown.*  
Duntroon; Gamrie.
- subtruncata*, *Da Costa.*  
Cumbrae Coll.; Kilchattan.
- subtruncata*, *var. striata*, *Brown.*  
Dalmuir.

**LUTRARIA**, *Lamarck.*

- elliptica*, *Lam.*  
Kyles of Bute; Lucknow Pit.

**SCROBICULARIA**, *Schumacher.*

- alba*, *Wood.*  
Dalmuir; Lochgilp; Garvel Park; West Tarbert; Duntroon;  
Garvel Water.
- prismatica*, *Mont.*  
Lochgilp; Kilchattan.

## FAMILY SOLENIDÆ

**SOLECURTIS**, *De Blainville.*

- candidus*, *Renier.*  
Caithness (Peach).

## FAMILY ANATINIDÆ

**THRACIA**, *Leach.*

- myopis*, *Beck.*  
Ellie; Errol; Greenock.
- papyracea*, *Pol.*  
Kyles of Bute and Lochgilp (Prof. Geikie).

## FAMILY CORBULIDÆ

**CORBULA**, *Bruguière.*

- gibba*, *Olivi.*  
East Tarbert; Tangy Glen.

## FAMILY MYIDÆ

*MYA*, Linné.*truncata*, Linn.

Common in the glacial deposits of Scotland.

*truncata*, var. *Uddevallensis*.

Dalmuir; Lochgilp; Kyles of Bute; Wick.

*arenaria*, Linn.

Lochgilp, one valve; Bute (Smith).

## FAMILY SAXICAVIDÆ

*SAXICAVA*, *Fleurian de Bellevue*.Norvegica, *Spengler*.

Kyles of Bute; Fairlie; Langbank; Gourrock; Belhelvie; Caithness, in boulder-clay.

Synonyms. *Panopæa Arctica*, *Gould*; *P. Bivona*, *Smith*; *P. Norvegica*, *Forbes and Hanley*.

This species, in the West of Scotland, has always been found near, or within, tide-mark. It may be remarked that those at Kyles of Bute, Fairlie, and of valves cast ashore in Balloch Bay, Cumbræ, are large, while those at Langbank are much smaller.

*rugosa*, Linn.

Garvel Park; Lochgilp; Dalmuir; E. and W. Tarbert; Old Mains; Paisley; Kilchattan; Kyles of Bute; Garnock Water; Cumbræ Coll.; Elie, Errol, and Caithness, in boulder-clay.

*rugosa*, var. *Arctica*, Linn.

Jordanhill; Garvel Park; Kyles of Bute; Dalmuir; Lochgilp; East Tarbert.

*rugosa*, var. *precisa*, *Mont.*

Lochgilp, one valve.

*rugosa*, var. *sulcata*, *Smith*.

Paisley; Rothesay; Kyles of Bute; Montrose; Annochie; Ellishill, and Belhelvie.

## FAMILY PHOLADIDÆ

*PHOLAS*, *Lister*.*crispata*, Linn.

Cumbræ Coll.; Garvel Park; Kilchattan; Stevenston (Landsborough); Gamrie; King Edward.

*dactylus*, Linn.

Stevenston (Landsborough); Ayr (Smith).

*Solenococonchia*.

## FAMILY DENTALIIDÆ

*DENTALIUM*, Linné.*entalis*, Linn.

King Edward; Gamrie; Belhelvie, Wick, in boulder-clay.

*abyssorum*, *Sars*.

Caithness, in boulder-clay.

## Gasteropoda.

## FAMILY CHITONIDÆ.

CHITON, *Linné.**marmoreus, Fabr.*Garvel Park; Dalmuir; Old Mains; Lochgilp; Garnock Water;  
Fort William (Jeffreys).*ruber, Linn.*

Garvel Park; Dalmuir; Lochgilp; Fort William (Jeffreys).

*cinereus, Linn.*

Garvel Park; Lochgilp; Fort-William; Caithness, in boulder-clay.

*albus, Linn.*

Fort-William (Jeffreys).

## FAMILY PATELLIDÆ.

PATELLA, *Lister.**vulgata, Linn.*

Fort-William (Jeffreys); Caithness, in boulder-clay; Lucknow Pit.

HELICION, *De Montfort.**pellucidum, Linn.*

Garnock Water; Lochgilp; Dalmuir.

*var. lævis, Penn.*

Dalmuir; Banffshire (Forbes).

TECTURA, *Cuvier.**virinea, Müll.*Garvel Park; Dalmuir; West Tarbert; Old Mains; Paisley;  
Lochgillp; Kilchattan; Kyles of Bute; Garnock Water; Cumbræ Coll.; Gamrie.

## FAMILY FISSURELLIDÆ.

PUNCTURELLA, *R. T. Lowe.**Noachina, Linn.*Garvel Park; Dalmuir; Old Mains; Lochgilp; Garnock Water;  
Cumbræ Coll.; Fort-William.FISSURELLA, *Bruguidre.**Græca, Linn.*Clyde beds (Forbes). Syn. *F. reticulata*, F. & H.

## FAMILY TROCHIDÆ.

CYCLOSTREMA, *Marryat.**costulata, Möll.*

Paisley (Crosskey); Fort-William (Jeffreys).

TROCHUS, *Rondeletius.**helacinus, Fabr.*Jordanhill; Garvel Park; Dalmuir; East Tarbert; Paisley;  
Cumbræ Coll.; Oban and Fort-William.*Grœnlandicus, Chemn.*

Jordanhill; Garvel Park; Dalmuir; Old Mains; Paisley; Lochgilp; Garnock Water; Cumbræ Coll.; Fort-William; Errol; Caithness.

**TROCHUS**—*continued*.*tumidus*, *Mont.*

Garvel Park; Old Mains; Lochgilp; Kilchattan; Kyles of Bute; Cumbræ Coll.; Garnock Water; Fort-William.  
*VahlII*, *Möller*.

*Paisley*.  
*zizyphinus*, *Linn.*

Caithness, in boulder-clay.  
*cinereus*, *Couth.*

Clyde beds (Jeffreys).  
*cinerarius*, *Linn.*

Lochgilp; Garvel Park; Kilchattan; Garnock Water; Lucknow Pit, Stevenston (Landsborough).  
*millegranus*, *Phil.*

Fort-William.  
*magus*, *Linn.*

Clyde beds (Smith); Lucknow Pit.

**MÖLLERIA**, *Jeffreys*.*costalata*, *Möll.*

Garvel Park.

**MARGARITA**, *Leach*.*cinerea*, *Couth.*

Bute (Prof. Geikie); Rothesay (Smith).

*olivacea*, *Brown.*

Clyde beds (Jeffreys).

## FAMILY LITTORINIDÆ

**LACUNA**, *Turton*.*divaricata*, *Fabr.*

Jordanhill; Garvel Park; Dalmuir; West Tarbert; Duntroon; Old Mains; Paisley; Lochgilp; Kilchattan; Kyles of Bute; Garnock Water; Cumbræ Coll.; King Edward; Fort-William.

*divaricata*, *var. quadrifasciata*, *Montf.*

Dalmuir.

*puteolus*, *Turt.*

Dalmuir; Paisley; Garvel Park; Cumbræ Coll.; Fort-William.

*pallidula*, *Da Costa*.

Lochgilp; Dalmuir.

*pallidula*, *var. neritoidea*, *Gould*.

Dalmuir; Fort-William.

**LITTORINA**, *Ferussac*.*littorea*, *Linn.*

Jordanhill; Garvel Park; Dalmuir; Paisley; Lochgilp; Kilchattan; Kyles of Bute; E. and W. Tarbert; Crinan; Old Mains; Cumbræ Coll.; Windmillcroft; Croftamie; Caithness.

*rudis*, *Maton*.

Jordanhill; Garvel Park; Dalmuir; Paisley; Lochgilp; Kilchattan; Garnock Water.

*rudis*, *var. saxatilis*, *Johnston*.

Garvel Park.



LITTORINA—*continued.**rudis*, var. *patula*, *Jeffreys*.

Dalmuir; Bute (Smith).

*obtusata*, *Linn.*

Garvel Park; Dalmuir; E. and W. Tarbert; Crinan; Old Mains; Paisley; Lochgilp; Kilchattan; Kyles of Bute; Garnock Water; Caithness, in boulder-clay.

*obtusata*, var. *neritiformis*, *Brown*.

East Tarbert.

*limata*, *Loven*.

Jordanhill; Garvel Park; Dalmuir; E. and W. Tarbert; Paisley; Lochgilp; Crinan.

*squalida*, *Brood. and Sow.*

Paisley; Fort-William; Ellishill; Invernettie Railway Cutting between Drymen and Gartness, in gravel (Jamieson).

RISSEO, *Fremerville*.*violacea*, *Desm.*

Lochgilp.

*striata*, *Adams*.

Jordanhill; Dalmuir; West Tarbert; Duntroon; Old Mains; Paisley; Lochgilp; Kilchattan; Kyles of Bute; Garnock Water; Cumbræ Coll; Garvel Park.

*striata*, var. *Arctica*, *Loven*. Syn. *R. saxatilis*, *Möll.*

Garvel Park; Paisley.

*parva*, *Da Costa*.

Garvel Park; West Tarbert; Duntroon; Paisley; Fort-William.

*parva*, var. *interrupta*, *Adams*.

Jordanhill; Garvel Park; Dalmuir; West Tarbert; Duntroon; Old Mains; Paisley; Lochgilp; Kilchattan; Kyles of Bute; Garnock Water; Caithness.

*soluta*, *Phil.* Syn. *R. globosa*, *Mart.*

Paisley.

*inconspicua*, *Alder*.

Jordanhill.

*inconspicua*, var. *ventrosa*, *Mont.*

Dalmuir (Smith).

*membranacea*, *Adams*.

Bute (Smith).

*reticulata*, *Mont.*

Lochgilp; Paisley.

*cancellata*, *Da Costa*.

Lochgilp.

*striatula*, *Mont.*

Lochgilp.

*costata*, *Adams*.

Largs (Landsborough).

MENESTHO, *Möller*.*albula*, *Fabr.*

Paisley.

HYDROBIA, *Hartmann*.*ulvæ*, *Penn.*

Dalmuir; Paisley.

## FAMILY SKENEIDÆ

SKENEIA, *Fleming*.planorbis, *Fabr.*

Not uncommon in most of the Post-Tertiary beds in the West of Scotland.

HOMALOGYRA, *Jeffreys*.atomus, *Phil.*

Moderately common in most of the Post-Tertiary beds in the West of Scotland.

## FAMILY TURRITELLIDÆ

TURRITELLA, *Lamarck*.terebra, *Linn.*

Caithness, in boulder-clay; King Edward, and Auchleuchries (Jamieson).

erosa, *Couth.*

Elie.

reticulata, *Migh. and Adams.*

King Edward (Jamieson).

## FAMILY SCALARIDÆ

SCALARIA, *Lamarck*.Groenlandica, *Chemn.*

King Edward (Jamieson); Fairlie.

## FAMILY PYRAMIDELLIDÆ

ODOSTOMIA, *Fleming*.unidentata, *Mont.*

Lochgilp; Garvel Park; Kilchattan.

turrita, *Hanley.*

Lochgilp.

spiralis, *Mont.*

Lochgilp; Dalmuir; Garvel Park.

Lukisi, *Jeffreys.*

Garvel Park.

conoidea, *Brocchi.*

Lochgilp.

pallida, *Mont.*

Lochgilp.

albella, *Lovén.*

Caithness, in boulder-clay.

acicula, *Phil.*

Caithness, in boulder-clay.

## FAMILY NATICIDÆ

NATICA, *Adanson*.affinis, *Gmelin.* Syn. *N. clausa*, *Brod. and Sow.*

Garvel Park; Dalmuir; West Tarbert; Duntroon; Old Mains; Paisley; Lochgilp; Kilchattan; Kyles of Bute; Cumbræ Coll.; Garnock Water; Gourock; Gamrie; King Edward; Caithness, in boulder-clay.

**NATICA**—*continued.**Greenlandica, Beck.*

Jordanhill; Garvel Park; Old Mains; Kilchattan; Arklieston, near Paisley; Kilmaurs, under boulder-clay; Elie; Errol.  
*pallida, Brod. & Sow.*

Dalmuir; Paisley; Kilchattan, and Elie, Gamrie; Errol; Caithness, in boulder clay (Jamieson). There is some doubt regarding *N. pallida*. Jeffreys considers that it is difficult to decide from the too short diagnosis given by Broderip and Sowerby whether their *N. pallida* is *N. Greenlandica* or *N. Islandica*.<sup>1</sup> The same author, in his list of Uddevalla Upper Tertiary fossils gives *N. Greenlandica* as a synonym of *N. pallida*.<sup>2</sup> With this doubt, therefore, it may create less confusion if we retain *N. pallida* as distinct from the preceding species.

*Alderi, Forbes.*

King Edward; Caithness, in boulder-clay.  
*fragilis, Leach.* Syn. *N. catena, Da Costa.*

*Dalmuir (Smith).**Montacuti, Forbes.*

Clyde beds (Smith).

*Smithii, Brown.*

Ardincaple, near Helensburgh.

*sordida, Phil.*

Caithness, in boulder-clay (Peach).

*glaucinoidea, Sowerby.*

Recorded by Dr. Thos. Thomson<sup>3</sup> in his list of Dalmuir shells, but since the so-called *N. glaucinoidea* is said to be very common, it is most probable that it is *Natica affinis, Gmel.*, which is the characteristic shell of the deposit. *N. glaucinoidea* has also been recorded by Jamieson from King Edward and Gamrie, and by Landsborough from Stevenston; but to these the same reason for identification may not apply. Forbes regarded this fossil as identical with *N. monilifera*, syn. *N. catena*.

## FAMILY VELUTINIDÆ.

**VELUTINA, Fleming.***lævigata, Penn.*

Garvel Park; Dalmuir; Crinan; Kilchattan.

*undata, Smith.*

Garvel Park; Dalmuir; Old Mains; Paisley (Jamieson); Garnock Water, very abundant.

## FAMILY CANCELLARIIDÆ.

**TRICHOTROPIS, Broderip and Sowerby.***borealis, Brod. & Sow.*

Garvel Park; Kyles of Bute.

<sup>1</sup> *British Conchology*, iv. p. 218.

<sup>2</sup> Jeffreys, *Report Brit. Assoc.* 1862.

<sup>3</sup> *Rec. Gen. Science*, 1885, vol. i. p. 130.

## FAMILY APORRHAIDÆ

APORRHAIS, *Da Costa*.pes-pellicani, *Linn.*

Kilchattan; Gourock; King Edward; Caithness, in boulder-clay.

## FAMILY CERITHIADÆ

CERITHIUM, *Adanson*.reticulatum, *Da Costa*.

Cumbrae Coll.; Lochgilp; Duntroon; Garnock Water.

## FAMILY CERITHOPSIDÆ

CERITHIOPSIS, *Forbes and Hanley*.costulata, *Müll.*

Wick, in boulder-clay (Peach).

## FAMILY BUCCINIDÆ

PURPURA, *Bruguière*.lapillis, *Linn.*

Jordanhill; Dalmuir; E. and W. Tarbert; Crinan; Paisley; Lochgilp; Kilchattan; Cumbrae Coll.; Lucknow Pit, Stevenston; Loch Long (Prof. Geikie); Caithness.

BUCCINUM, *Linn.*Greenlandicum, *Chemn.*

West Tarbert; Old Mains; Paisley; Garnock Water.

undatum, *Linn.*

Gamrie; Caithness, in boulder-clay; and generally common in the shell-bearing clays of the West of Scotland.

ciliatum, *Fabr.*

Bute (Forbes).

## FAMILY MURICIDÆ

MUREX, *Linn.*erinaceus, *Linn.*

Dalmuir (Smith).

TROPHON, (?) *De Montfort*.clathratus, *Linn.*

Dalmuir; Lochgilp; West Tarbert; Duntroon; Old Mains; Paisley; Garvel Park; Kilchattan; Kyles of Bute; Rothessay; Garnock Water; Gamrie; Belhelvie; King Edward.

clathratus, var. *Gunneri, Lovén.*

Dalmuir; Duntroon; Old Mains; Garvel Park; Paisley; Kyles of Bute; Garnock Water; Gamrie; King Edward.

truncatus, *Ström.*

Dalmuir; Garvel Park; West Tarbert; Duntroon; Old Mains; Paisley; Lochgilp; Kilchattan; Kyles of Bute.

FUSUS, *Bruguière*.antiquus, *Linn.*

Cumbrae Coll.; West Tarbert; Paisley; Lochgilp; Kyles of Bute; Garvel Park; Gourock; Croftamie; Caithness, in boulder-clay.

**FUSUS**—*continued.**gracilis*, *Da Costa.*

Dalmuir.

*propinquus*, *Alder.*

Lochgilp (Prof. Geikie); Gamrie; King Edward.

*despectus*, *Linn.*

Dalmuir (Forbes); Kippit Hill; Loch of Stains, Aberdeenshire (Jamieson).

## FAMILY NASSIDÆ

**NASSA**, *Lamarck.**incrassata*, *Ström.*

Caithness, in boulder-clay; King Edward; Kyles of Bute (Prof. Geikie); Dalmuir (Smith); Lochgilp.

**COLUMBELLA**, *Lamarck.**Holbölli*, *Müller.*

Fort-William (Jeffreys).

## FAMILY PLEUROTOMITIDÆ

**DEFRANCIA**, *Miller.**Leufroyi*, *Michaud.*

Wick, in boulder-clay.

*linearis*, *Mont.*

Garvel Park.

**PLEUROTOMA**, *Lamarck.**pyramidalis*, *Ström.*

Dalmuir; Cumbræ Coll.; Lochgilp; West Tarbert; Crinan; Duntroon; Paisley; Kilchattan; Kyles of Bute; Garnock Water; Garvel Park; Fort-William (Jeffreys); Caithness; King Edward; Gamrie.

*turricula*, *Mont.*

Cumbræ Coll.; West Tarbert; Duntroon; Paisley; Garvel Park; Kilchattan; Kyles of Bute; Garnock Water; Oban (Prof. Geikie); Caithness; Gamrie; King Edward.

*violacea*, *Migh. & Ad.*

Dalmuir; Cumbræ Coll.; Lochgilp; Old Mains; Garvel Park; Kilchattan; Garnock Water.

*nebula*, *Mont.*

Caithness (Jamieson).

*Trevelyana*, *Turt.*

Wick (Peach); King Edward; Gamrie (Jamieson); West Tarbert; Kilchattan; Garvel Park; Hebrides (Jeffreys).

## FAMILY BULLIDÆ

**UTERONIA**, *Loven.**alba*, *Brown.*

Dalmuir; Lochgilp; Duntroon; Paisley; Kyles of Bute; Garnock Water; Garvel Park; Annochie; Gamrie.

*cylindracea*, *Penn.*

Paisley.

*obstricta*, *Gould.*

Dalmuir; Lochgilp.

*UTRICULUS, Brown.**hyalinus, Turt.*Dalmuir; Cumbræ Coll.; Duntroon; Paisley; Garvel Park;  
Kilchattan.*obtusius, Mont.*Cumbræ Coll.; Lochgilp; West Tarbert; Duntroon; Paisley;  
Garvel Park; Kilchattan; Kyles of Bute; Garnock Water.*truncatulus, Brug.*

Duntroon.

*mammillatus, Phil.*

Dalmuir; Arklieston, near Paisley.

*ACTÆON, De Montfort.**tornatilis, Linn.*

Caithness, in boulder-clay; Lochgilp.

*TORNATELLA, Lamarck.**pyramidata, Forbes.*Aberdeenshire (Smith *vide* Jamieson).*SCAPHANDER, De Montfort.**lignarius, Linn.*Recorded from Greenock New Dock; very doubtful if glacial,  
as much of the earth in the cutting had been forced or banked  
up with materials containing marine recent shells.

## MAMMALIA.

As the mammalian remains have been, with the exception of the Cetaceans, subjected to a far greater range of temperature than the marine Invertebrata, we place separately, for ready comparison, (a) those mammals that have been found underlying the boulder-clay; (b) those found imbedded in it; and (c) those overlying it. The life-range of the individual species found in these deposits will thus be seen at a glance.

## (a.) FOUND UNDERLYING BOULDER-CLAY.

*CERVUS, Linn.**tarandus, Linn.* Reindeer.Greenhill Quarry, Kilmaurs (horns in Hunterian Museum,  
Glasgow University); Croftamie, Endrick Valley, Dumbarton-  
shire, in blue clay with shells (Dr. J. A. Smith, *Proc. Soc. Ant.*  
*Scot.* 1871).*ELEPHAS, Linn.**primigenius, Blum.* Mammoth.Chapelhall, near Airdrie. A bone of this species found in  
laminated sand 350 feet above the level of the sea (Craig,  
*Proc. Geol. Soc. Glasgow*, iii. p. 415).At Greenhill Quarry, Kilmaurs, in a peaty deposit, containing  
the seeds of *Ranunculus* and *Potamogeton*, and underlying sand  
in which were Post-Tertiary marine shells; the whole overlaid  
by 40 or 50 feet of boulder-clay (Bald, *Mem. Wernerian Soc.*  
iv. p. 64).

## (b.) FOUND IN BOULDER-CLAY.

**CERVUS TARANDUS**, *Linn.*

Right antler of this species found at Raes Gill, Carlisle, Lanarkshire. Specimen in Hunterian Museum, Glasgow University (J. Young, *Proc. Nat. Hist. Soc. Glasgow*, ii. p. 5).

**ELAPHAS PRIMIGENTIUS**, *Blum.*

A tusk was found during the excavation of the Union Canal between Edinburgh and Falkirk (Bald, *Mem. Wernerian Soc.* iv. p. 58), and remains at Cliftonhall, 15 to 20 feet below the surface; also at Bishopbriggs, a molar tooth, which is in the possession of Professor Allen Thomson, Glasgow University (Bryce, *Geology of Arran and Clydesdale*).

## (c.) FOUND OVERLYING BOULDER-CLAY.

**BOS**, *Linn.*

*primigenius*, *Bojanus*. Great Fossil Ox.

Head and horns in the bed of the Clyde opposite Jordanhill (Scouler, *Trans. Geol. Soc. Glasgow*, ii. p. 167); in clay, Rothesay Bay (Professor Geikie); skull and horn-core at Cowdenglen, Renfrewshire, in a peaty bed 5 or 6 feet from the surface (J. Geikie, *Geol. Mag.* v. p. 393; and a horn at Glasgow in Greendyke Street, during the excavation of a sewer, in silt 7 feet from the surface (J. Bennie, *Trans. Geol. Soc. Glasgow*, ii. p. 152).

*longifrons*, *Owen*. Long-fronted or Small Fossil Ox.

In a peat-moss on the side of Williestruther Loch, Roxburghshire (Dr. J. A. Smith, *Proc. Soc. Ant. Scot.* 1871). In Rutherglen Loan, Glasgow, in river sand and gravel a portion of the skull (J. Bennie, *Trans. Geol. Soc. Glasgow*, ii. p. 152).

**CERVUS**, *Linn.*

*alces*, *Linn.*

In marl, under moss at Arleywright, Perthshire (Smith of Jordanhill); specimens, portion of a skull and horns are now in the Hunterian Museum, Glasgow. The remains of this species have also been found in a marl pit in Forfarshire, and in clay and gravel at Strath Halladale in Sutherlandshire.

*tarandus*, *Linn.*

In the bed of the Clyde opposite Jordanhill (Dr. Scouler).

**MEGACEROS**, *Owen*.

*Hibernicus*, *Owen*. Gigantic Irish Deer.

Part of a horn at Cowdenglen, Renfrewshire, in a peaty bed 15 feet from the surface (Craig, *Trans. Geol. Soc. Glasgow*, iv. p. 18). Specimen in Hunterian Museum.

**EQUUS**, *Linn.*

*caballus*, *Linn.*

A few bones at Cowdenglen, Renfrewshire (Craig, *Trans. Geol. Soc. Glasgow*, iv. p. 18). Specimens in Hunterian Museum.

**PAGOMYS**, *J. E. Gray*.

*foetidus*, *Gray*.

At Camelon near Grangemouth in a bed of clay 90 feet above

the level of the Firth of Forth and in a pit on Towncroft Farm, Grangemouth (Turner, *Proc. Roy. Soc. Edin.* 1869-70, pp. 105-114). Several bones were found in red clay 80 feet from the surface, and about 68 feet below the level of the sea.

#### WHALE.

The remains of whales have been found in the higher parts of the estuary of the Forth; at Airthrie, near Stirling, 1 mile from the river and 7 from the sea; at Dunmore below Stirling, a skeleton 85 feet long, and as at Airthrie about 20 feet above high-water mark. At Blair Drummond, 14 miles from the sea, three skeletons, between 20 and 30 feet above the sea. At Airthrie and Blair Drummond human implements were got with the whales. On the banks of the Irvine Water, about 2 miles from the sea, portions of a large skull were found in sand 18 feet above the stream. At Bridge of Allan a skull was got which is now in the Andersonian Museum, Glasgow.

#### AVES.

Bones, not determined.  
Paisley; Dalmuir.

#### PISCES.

Vertebræ and otolites.  
Old Mains; Garvel Park; Lochgilp.

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## LIST OF MINERALS AND ROCK SPECIMENS

Found in the Central, Southern, and Western Districts of Scotland. Compiled by DAVID CORSE GLEN, C.E., F.G.S., and JOHN YOUNG, JUN.

The following list of Minerals and Rock Specimens has been made up from those recorded in various mineralogical works, the *Memoirs of the Geological Survey of Scotland*, and from the specimens contained in the Hunterian Museum, University of Glasgow, as well as from specimens contained in private collections. The compilers wish to state that the very limited time allowed them for drawing up the list before printing forbids them offering it to the public as a complete or exhaustive list; nor can they say that it contains any mineral species or rock specimens not formerly recorded from the above districts. They, however, hope that in the form in which it is now presented it may prove useful and serve as an index to the chief varieties that have been found.

### MINERALS.

The names adopted for mineral species are in Roman type; other names used as synonyms are printed in *Italics*.

<i>Acerdese.</i>	<i>v.</i> Manganite.
<i>Achmatite.</i>	<i>v.</i> Epidote.
<i>Actinolite.</i>	<i>v.</i> Amphibole.
<i>Agate.</i>	<i>v.</i> Quartz.
<i>Amethyst.</i>	<i>v.</i> Quartz.
Amphibole.	(Tremolite)—Carleton Castle; Inverary; Lewis; Harris.
Do.	(Actinolite)—Skye; Lewis; Harris.
Do.	(Hornblende)—Ayrshire; Iona; Coll.
Do.	(Anthophyllite)—Girvan.
Do.	(Asbestus)—Girvan.

<b>Amphibole.</b>	(Mountain leather)—Leadhills; Strontian.
<b>Analcite.</b>	Barrhead; Kilpatrick Hills; Kilmalcolm; Strontian; Mull; Inverkip.
<i>Anatase.</i>	v. Octahedrite.
<i>Andreolite.</i>	v. Harmotome.
<b>Anglesite.</b>	Wanlockhead.
<i>Anthophyllite.</i>	v. Amphibole.
<i>Anthracite.</i>	v. Mineral Coal.
<i>Antimonite.</i>	v. Stibnite.
<b>Apophyllite.</b>	Skye; Strontian; Kilpatrick Hills.
<b>Aragonite.</b>	Campsie; Shettleston pits; Greenock Hills.
<b>Argentite.</b>	Alva (with native silver); Bathgate.
<i>Asbestos.</i>	v. Amphibole.
<i>Asbolite.</i>	v. Wad.
<b>Asphaltum.</b>	Hurlet; Bishopbriggs; Bathgate.
<i>Augite.</i>	v. Pyroxene.
<b>Azurite.</b>	Leadhills.
<b>Barite.</b>	Bridge of Allan; Eaglesham; Strontian; Leadhills; Bute; Arran; Corrieburn.
<b>Biotite.</b>	Skye.
<b>Bismuth.</b>	Alva.
<i>Bitter Spar.</i>	v. Dolomite.
<i>Bitumen.</i>	v. Asphaltum.
<i>Blackband Ironstone.</i>	v. Siderite.
<i>Black-jack.</i>	v. Blende.
<i>Black-lead.</i>	v. Graphite.
<b>Blende.</b>	Leadhills; Strontian; Newton-Stewart.
<i>Bloodstone.</i>	v. Quartz.
<b>Brewsterite.</b>	Strontian.
<i>Bronzite.</i>	v. Enstatite.
<i>Brown Coal.</i>	v. Mineral Coal (Lignite).
<i>Byssolite.</i>	v. Amphibole (Tremolite).
<b>Calamine.</b>	Leadhills.
<i>Calcareous Spar.</i>	v. Calcite.
<i>Chalcedony.</i>	v. Chalcedony.
<b>Calcite.</b>	Cadder pits; Leadhills; Kilpatrick Hills; Kilmalcolm; Beith; Barrhead.
<b>Do.</b>	(Purple)—Dunlop.
<b>Do.</b>	(Fibrous)—Skye.
<b>Do.</b>	(Rock-milk)—From tile-clay, Lanfine.
<b>Do.</b>	(Marble)—Skye.
<b>Do.</b>	(Plumbo-calcite)—Leadhills.
<i>Cannel Coal.</i>	v. Mineral Coal.
<i>Capillary Pyrites.</i>	v. Millerite.
<i>Carnelian.</i>	v. Quartz.
<i>Cerussite.</i>	Leadhills.
<i>Cervantite.</i>	New Cumnock.
<b>Chabasite.</b>	Kilmalcolm; Skye; Kilpatrick Hills; Mull; Scuir of Eigg.

<i>Chalcanthite.</i>	Wanlockhead.
<i>Chalcedony.</i>	v. Quartz.
<i>Chalcocite.</i>	Ayrshire.
<i>Chalcopyrite.</i>	Inverneil.
<i>Chalybite.</i>	v. Siderite.
<i>Chessylite.</i>	v. Azurite.
<i>Chrysocolla.</i>	Leadhills; Bridge of Allan.
<i>Chrysolite.</i>	Kilpatrick and Renfrewshire Hills.
<i>Coal.</i>	v. Mineral Coal.
<i>Cobalt, earthy.</i>	v. Wad (Asbolite).
<i>Cone-in-cone Ironstone.</i>	v. Siderite.
<i>Copper.</i>	(Native)—Barrhead; Stirling; Mauchline.
<i>Copper Glance.</i>	v. Chalcocite.
<i>Copper Pyrites.</i>	v. Chalcopyrite.
<i>Copper Sulphate.</i>	v. Chalcanthite.
<i>Crispate.</i>	v. Rutile.
<i>Datholite.</i>	Kilpatrick Hills; Bishopton; Barrhead.
<i>Delphinite.</i>	v. Epidote.
<i>Diagonite.</i>	v. Brewsterite.
<i>Diallage.</i>	v. Pyroxene.
<i>Dillenburghite.</i>	v. Chrysocolla.
<i>Dioxyllite.</i>	v. Lanarkite.
<i>Dog-tooth Spar.</i>	v. Calcite.
<i>Dolomite.</i>	Iona; Leadhills; Gourock; Cathcart; Fintry; Bute.
<i>Edingtonite.</i>	Kilpatrick Hills.
<i>Eisen-Nickelkies.</i>	v. Pentlandite.
<i>Engelhardtite.</i>	v. Zircon.
<i>Enstatite.</i>	Skye; Lendalfoot.
<i>Epidote.</i>	Glencoe; Bute; Arran; Iona; Skye; Mull.
<i>Epistilbite.</i>	Skye.
<i>Erythrite.</i>	v. Feldspar (Orthoclase).
<i>Faröelite.</i>	v. Thomsonite.
<i>Feldspar.</i>	(Labradorite)—Campsie; Milngavie; Skye.
Do.	(Orthoclase—ordinary)—Iona; Arran; Bute; Lanark; Kilpatrick Hills.
Do.	(Orthoclase—Erythrite)—Kilpatrick.
Do.	(Orthoclase—Pitchstone)—Arran; Scuir of Eigg.
Do.	(Orthoclase—Obsidian)—Rum; Skye.
Do.	(Orthoclase—Spherulite)—Arran.
Do.	(Orthoclase—Weissigite)—Campsie Hills; Kilpatrick Hills; Hartfield Moss).
<i>Flint.</i>	v. Quartz.
<i>Fluor Spar.</i>	Gourock.
<i>Galena.</i>	Inverneil; Bathgate; Leadhills; Lesmahagow; Stron- tian.
<i>Garnet.</i>	Glenbucket; Strontian; Mull.
<i>Glauconite.</i>	Old Kilpatrick; Little Cumbræ.

Gmelinite.	Skye.
Gold.	Leadhills.
Göthite.	Kilpatrick Hills.
Graphite.	New Cumnock; Oban; Mull.
Greenockite.	Erschine; Bishopton; Kilpatrick Hills.
Gypsum.	(White Fibrous)—Auchenreoch Glen; Hurlet.
Do.	(Yellow Fibrous)—Spout of Ballagan.
Do.	(Red amorphous)—Spout of Ballagan.
Gyrolite.	Skye.
Hæmatite.	Leadhills.
Do.	(Specular Iron)—Islay; Galston; Kilpatrick; Bute.
Halotrichite.	Campsie; Hurlet.
Harmotome.	Strontian; Kilpatrick Hills; Campsie Hills.
Heavy Spar.	v. Barite.
Heliotrope.	v. Quartz.
Hematite.	v. Hæmatite.
Hemimorphite.	v. Calamine.
Heulandite.	Kilpatrick Hills; Kilmalcolm; Stockie Muir; Campsie Hills.
Hornblende.	v. Amphibole.
Hornstone.	v. Quartz.
Humboldtite.	v. Datholite.
Hydrolite.	v. Gmelinite.
Hypersthene.	Skye.
Iron Alum.	v. Halotrichite.
Iron Carbonate.	v. Siderite.
Iron Magnetic Oxide.	v. Magnetite.
Iron Pyrites.	Dunoon; Leadhills.
Iserinc.	v. Menaccanite.
Jasper.	v. Quartz.
Labradorite.	v. Feldspar.
Lanarkite.	Leadhills.
Laumontite.	Erschine; Kilmalcolm; Kilpatrick Hills; Cloak; Mugdock.
Leadhillite.	Leadhills.
Lead Phosphate.	v. Pyromorphite.
Lead Sulphate.	v. Anglesite.
Lead Sulphide.	v. Galena.
Lepidolite.	Loch Leven.
Leuchtenbergite.	Inverary; Perthshire.
Levyneite.	Hartfield Moss; Skye.
Lignite.	v. Mineral Coal.
Limonite.	Lochfyne.
Lincolnite.	v. Heulandite.
Lithia Mica.	v. Lepidolite.
Magnesite.	Inch Moran, Loch Lomond.
Magnetic Pyrites.	v. Pyrrhotite.

Magnetite.	Loch Long; Bute; East Rona; Islay.
Malachite.	Bridge of Allan; Leadhills.
Manganese.	( <i>Dendritic</i> ).— <i>v.</i> Wad.
Manganite.	Islay.
Marble.	<i>v.</i> Calcite.
Marcasite.	Alva.
Melaconite.	Leadhills.
Melanterite.	Hurlet; New Kilpatrick.
Menaccanite.	Bute; Cantyre.
Mesolite.	Kilpatrick Hills; Hartfield Moss; Skye; Sciur of Eigg.
Mesotype.	<i>v.</i> Thomsonite.
Do.	( <i>Soda</i> ).— <i>v.</i> Natrolite.
Do.	( <i>Lime</i> ).— <i>v.</i> Scolecite.
Do.	( <i>Lime and soda</i> ).— <i>v.</i> Mesolite.
Meteorite.	Fell at Possil, 5th April, 1804.
Mica.	Knapdale, Argyleshire.
Millerite.	Dunoon (in a boulder); Dockra, Beith.
Mimetite.	Leadhills.
Mineral Coal.	(Anthracite)—Hurlford; Shettleston; Barriston; Shotts.
Do.	(Free or common coal)—Lanarkshire; Ayrshire.
Do.	(Cannel)—Lanarkshire; Ayrshire.
Do.	(Lignite)—Portree; Skye.
Do.	(Torbanite)—Torbanehill; Bathgate.
Minium.	Leadhills.
Mirabilite.	Hurlet.
Molybdenite.	Loch Creran; Perthshire.
Molybdenum.	Loch Creran; Perthshire.
Mornite.	<i>v.</i> Feldspar (Labradorite).
Morvenite.	<i>v.</i> Harmotome.
Mountain Leather.	<i>v.</i> Amphibole.
Mussel-band Ironstone.	<i>v.</i> Siderite.
Natrolite.	Kilmalcolm; Port-Glasgow; Kilpatrick Hills; Cloak; Campsie Hills.
Niccolite.	Inverary; Dockra?
Obsidian.	<i>v.</i> Feldspar.
Octahedrite.	Earn, W. of Loch Lomond.
Okenite.	Carleton Castle.
Olivine.	<i>v.</i> Chrysolite.
Onyx.	<i>v.</i> Quartz.
Orthoclase.	<i>v.</i> Feldspar.
Panabase.	<i>v.</i> Tetrahedrite.
Pectolite.	Mugdock; Kilpatrick Hills; Kilsyth; Ballantrae; Skye.
Pentlandite.	Inverary.
Peridot.	<i>v.</i> Chrysolite.
Photolite.	<i>v.</i> Pectolite.
Pitchstone.	<i>v.</i> Feldspar.
Plumbo-calcite.	<i>v.</i> Calcite.

<i>Poonahllite.</i>	<i>v. Scolecite.</i>
<i>Prehnite.</i>	Kilpatrick Hills; Bishopton; Barrhead; Cloak; Beith.
<i>Psilomelane.</i>	Kilpatrick Hills; Rum; Leadhills.
<i>Pyromorphite.</i>	Leadhills; Strontian.
<i>Pyroxene.</i>	(Augite)—Rum; Canna; Mull; Arran; Skye; Harris.
Do.	(Diallage)—Ballantrae; Ailsa Craig; Uist; Iona.
Do.	(Sahlite)—Tiree.
<i>Pyrrhosiderite.</i>	<i>v. Göthite.</i>
<i>Pyrrhotite.</i>	Inverary; Appin.
<i>Quartz.</i>	(Rock Crystal)—Dumbarton Moor; Strontian; Ballachulish; Campsie Hills; Gourock.
Do.	(Amethystine)—Langbank; Galston; Leadhills; Cathcart Castle.
Do.	(Rose)—Shiant Islands.
Do.	(Milky)—Galston; North Uist.
Do.	(Ferruginous)—Bute; Stockie Muir.
Do.	(Chalcedony)—Galston; Rum.
Do.	(Carnelian)—Galston.
Do.	(Heliotrope)—Rum; Cantyre.
Do.	(Agate)—Galston; Ochila.
Do.	(Onyx)—Skye.
Do.	(Agate-Jasper)—Dunglass; Galston; Strathblane.
Do.	(Flint)—Dunoon.
Do.	(Hornstone)—Shiant Islands; Corrieburn.
Do.	(Jasper)—Galston; Spout of Ballagan; Islay; Dunglass.
<i>Ripidolite.</i>	Bute.
<i>Rochlandite.</i>	<i>v. Serpentine.</i>
<i>Rock Crystal.</i>	<i>v. Quartz.</i>
<i>Rock Milk.</i>	<i>v. Calcite.</i>
<i>Rutile.</i>	Killin; Glen Finnart.
<i>Sahlite.</i>	<i>v. Pyroxene.</i>
<i>Satin Spar.</i>	<i>v. Aragonite.</i>
<i>Scolecite.</i>	(Poonahllite)—Skye; Staffa; Mull.
Do.	(Mesotype)—Skye; Kilpatrick Hills.
<i>Serpentine.</i>	Bishopton; Carleton Castle; Ballantrae; Lendalfoot.
<i>Siderite.</i>	(Blackband)—Lanarkshire and Ayrshire Coalfields.
Do.	(Clayband) Do. do.
Do.	(Musselband) Do. do.
Do.	(Cone-in-cone) Do. do.
<i>Silver.</i>	(Native)—Alva.
<i>Smaltite.</i>	Alva; Inverary.
<i>Smithsonite.</i>	<i>v. Calamine.</i>
<i>Sodium Mesotype.</i>	<i>v. Natrolite.</i>
<i>Specular Iron.</i>	<i>v. Hematite.</i>
<i>Sphalerite.</i>	<i>v. Blende.</i>
<i>Spherulite.</i>	<i>v. Feldspar.</i>



<i>Stellite.</i>	<i>v.</i> Pectolite.
Stibnite.	New Cumnock.
Stilbite.	(Red)—Fintry Hills; Kilpatrick Hills; Carbeth.
Do.	(White)—Skye.
Do.	(Yellow)—Kilmalcolm.
Strontianite.	Strontian.
Talc.	Skye; Toward.
Tetrahedrite.	Bridge of Allan.
Thomsonite.	Kilpatrick Hills; Cloak; Skye; Kilmalcolm.
<i>Titanium Oxide.</i>	<i>v.</i> Rutile.
<i>Torbanite.</i>	<i>v.</i> Mineral Coal.
Tourmaline.	Mull.
<i>Tremolite.</i>	<i>v.</i> Amphibole.
<i>Tripoclase.</i>	<i>v.</i> Thomsonite.
Vanadinite.	Leadhills.
Wad.	(Dendritic Manganese)—Tinto; Leadhills.
Do.	(Asbolite)—Tyndrum.
Wavellite.	Shiant Islands.
<i>Weissigite.</i>	<i>v.</i> Feldspar (Orthoclase).
<i>White Lead Ore.</i>	<i>v.</i> Cerussite.
Willemite.	Wanlockhead.
<i>Zinc Carbonate.</i>	<i>v.</i> Calamine.
<i>Zinc Sulphide.</i>	<i>v.</i> Blende.
Zircon.	Strontian; Harris.

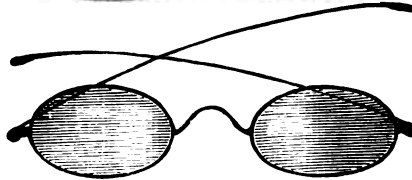
## ROCKS.

Agglomerate.	Auchenreoch Glen; Strathblane; Carluke; Ayr; Monkton; Patna.
Anthracite.	Shettleston; Shotts; Barriston.
<i>Cementstone.</i>	<i>v.</i> Limestone (Cement).
<i>Chert.</i>	<i>v.</i> Hornstone.
Clay.	(Brick)—Glasgow; Paisley; Jordanhill.
Do.	(Fire)—Garnkirk; Maryhill; Hurlford.
Coal.	(Free or Cherry)—Lanarkshire and Ayrshire Coalfields.
Do.	(Splint)—Lanarkshire and Ayrshire Coalfields.
Do.	(Cannel or Gas)—Lesmahagow; Skaterig; Bathgate.
Conglomerate.	S. of Girvan; Argyleshire (Silurian): Lesmahagow; Arran; by Bute and Dunoon to Perthshire (Old Red Sandstone): Craigmaddie (Carboniferous).
Diallage Rock.	Lendalfoot.
Diorite.	Colmonell; Glen App.

Dolerite.	Campsie Hills; Craig Park; Dalmellington; Muirkirk; Girvan; Gleniffer Glen.
Do.	(Basaltic <i>var.</i> )—Dunglass; Dumbuck; Cathkin; Fintry.
Felstone.	(Amygdaloidal)—Campsie, Strathblane and Renfrewshire Hills.
Do.	(Compact)—Glen App; Tinto; Darvel; Arran.
Do.	(Porphyritic)—Campsie; Straiton; Dalmellington; Darvel.
Do.	(Quartziferous)—Muirkirk; Bute; Arran.
Do.	(Vesicular)—Strathblane.
Flint.	(Bands in Limestone)—Beith; Dalry; Bathgate.
Gneiss.	(Hornblendic and micaceous)—Argyleshire and Western Islands.
Granite.	(Gray)—Arran; Ben Awe; Creeton.
Do.	(Red)—Ross of Mull; Ben Cruachan.
Do.	(Graphic)—Harris.
Do.	(Metamorphic)—Watstone Hill; Darvel ( <i>Geol. Survey</i> ).
Graphite.	Ballachulish (in slate); Hurlford (Carboniferous).
Grauwacke.	Argyle and Bute shires; South-western Scotland.
Grit.	(Felspathic)—Lanfine Moor; Dalmellington.
Do.	(Siliceous)—Lanarkshire and Ayrshire Coalfields.
Hornstone.	Corrieburn.
Ironstone.	(Black, Clay, and Mussel Bands)—Lanarkshire and Ayrshire Coalfields.
Limestone.	(Calmy)—Carluke; Garnkirk; East Kilbride; Arden.
Do.	(Cement)—Ayr; Orchard; Arden; East Kilbride.
Do.	(Coralline)—Beith; Corrieburn; Lesmahagow.
Do.	(Dolomitic)—Ballagan; Fintry; Inverkip; Toward.
Do.	(Encrinal)—Muirkirk; Beith; Campsie; Carluke.
Do.	(Shelly)—Beith; Campsie; Carluke.
Do.	(Altered)—Lendalfoot; Corrieburn.
Melaphyre.	Dunlop; Cathkin; Gleniffer Braes; Mearns; Beith.
Mudstone.	Girvan (U. Silurian); Glasgow and Ayrshire Coalfields (Carboniferous).
<i>Necks, Volcanic.</i>	<i>v. Agglomerate.</i>
Pitchstone.	Arran; Eigg.
Porphyrite.	(Amygdaloidal)—Kilpatrick and Campsie Hills; Dalmellington.
Do.	( <i>Felspathic</i> )— <i>v. Felstone</i> (Porphyritic).
Do.	(Ferruginous)—Eaglesham; Beith; Dunlop; Cathkin ( <i>Geol. Survey</i> ).
Do.	(Quartziferous)—Girvan; Bute; Arran.
<i>Puddingstone.</i>	<i>v. Conglomerate.</i>

Quartzite.	Argyleshire; Western Islands; Black Craig, Campsie.
Sandstone.	(White)—Bishopbriggs; Giffnock; Possil.
Do.	(Red)—Dumbarton; Wemyss Bay; Arran.
Do.	(Black, carbonaceous)—Bishopbriggs.
Do.	(Bituminous)—Cadder Pits.
Do.	(Micaceous)—Blantyre; Cambuslang; Uddingstone.
Do.	(Flaggy)—Giffnock; Bishopbriggs (Carboniferous): Kilmarnock (Old Red Sandstone).
Do.	(Felspathic)—Darvel; Dunure ( <i>Geol. Survey</i> ).
Schist.	(Mica)—Argyleshire.
Do.	(Chlorite)—Argyleshire; Bute.
Do.	(Talc)—Argyleshire.
Do.	(Hornblende)—Argyleshire; Western Islands.
Do.	(Actinolite)—Argyleshire; Western Islands.
Serpentine.	Lendalfoot; Girvan.
Shale.	(Aluminous)—Hurler; Campsie.
Do.	(Arenaceous)—Lanarkshire and Ayrshire Coalfields.
Do.	(Argillaceous) Do. do.
Do.	(Bituminous) Do. do.
Do.	(Calcareous)—Campsie; Carlisle; Beith.
Do.	(Ferruginous)—Lanarkshire and Ayrshire Coalfields.
Slate.	(Clay)—Dunoon; Ballachulish; Easdale.
Syenite.	Girvan; Argyleshire.
Tuff.	(Doleritic)—Heads of Ayr; Greenan Castle ( <i>Geol. Survey</i> ).
Do.	(Felspathic)—Dumbuck; Corrieburn; Arran; Darvel; Cathkin; Dundonald.
Do.	(Melaphyre)—Ballochmyle; Mossiel; Dalmellington ( <i>Geol. Survey</i> ).
Do.	(Porphyritic)—Maybole ( <i>Geol. Survey</i> ).

FINIS.



**BROWN'S  
OPTICAL & PHILOSOPHICAL  
INSTRUMENT DEPOT,  
76 ST. VINCENT STREET, GLASGOW.**

**SURVEYING INSTRUMENTS, DRAWING INSTRUMENTS AND MATERIAL.**

**SPECTACLES AND EYE GLASSES in Gold, Silver, Steel, and Tortoise-shell Frames.**

**MICROSCOPES by the best French and English Makers.**

**ANEROID BAROMETERS from Pocket size upwards, with and without Scale for Measuring Heights.**

**OPERA AND FIELD GLASSES, Achromatic, in all the various qualities.**

**PEDOMETERS, RADIOMETERS, THERMOMETERS.**

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**PHOTOGRAPHS OF SCOTTISH, SWISS, ITALIAN, AND OTHER SCENERY.**

**N.B.—State of Sight ascertained by Improved Optometer.**

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SCOTTISH PROVIDENT  
INSTITUTION.

(Established 1837.)

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GLASGOW—67 ST. VINCENT STREET.

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 ALEXANDER MITCHELL, Esq., Merchant, 33 Renfield Street.  
 JAMES HAY STUART, Esq., Commercial Bank, Gordon Street.  
 WILLIAM STEVENSON, Esq., Merchant, 23 West Nile Street.  
 THOMAS WHARRIE, Esq., C.E., 156 St. Vincent Street.

Medical Officer—Dr. J. G. WILSON, 9 WOODSIDE, CRESCENT.

THE TERMS of this INSTITUTION are specially adapted to the case of FAMILY SETTLEMENTS, where it is important to secure a competent provision of definite amount from the first, at the smallest possibly outlay.

Instead of charging rates admittedly higher than are necessary, and afterwards returning the excess, or a portion of it, in the shape of periodical Bonuses, it gives, from the first, as large an assurance as the Premiums will, with perfect safety, bear—reserving the Whole Surplus for those Members who live long enough to secure the common Fund from loss on account of their individual Assurances.

A Policy for £1200 to £1250 may thus in most cases be had for the Premium usually charged for £1000 only; while, by *reserving* the Surplus, large additions may be expected on the Policies of those who live to participate. In a few cases, Policies sharing at the whole four divisions have already been doubled.

THE ACCUMULATED FUNDS now exceed £2,650,000, having increased in last year by £229,882.

*Examples of Annual Premiums for £100 at Death (with Profits).*

Age	25	30	35	40	45	50
Payable during life,.....	£1 18 0	£2 1 6*	£2 6 10	£2 14 9	£3 5 9	£4 1 7
Limited to 21 Payments,	2 12 6	2 15 4	3 0 2	3 7 5	3 17 6	4 12 1

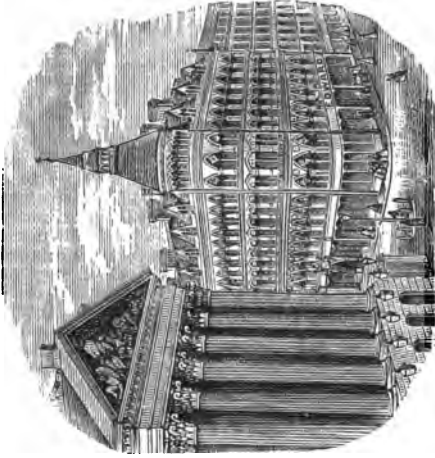
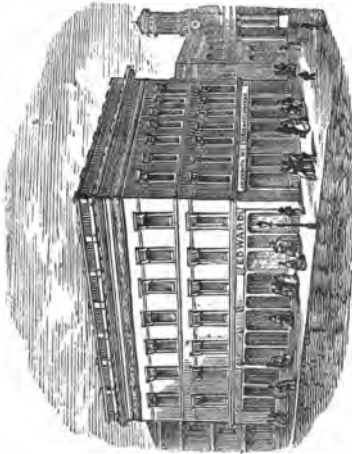
\* Thus, a person of 30 may secure £1000 at death by a yearly payment *during life* of £20, 15s. This Premium, if paid to any other of the Scottish Mutual Offices, would secure £800 only, instead of £1000.

OR he may secure the same sum of £1000 by *twenty-one* yearly payments of £27, 13s. 4d. At the age 40, the Premium *ceasing* at 60, is, for £1000, £33, 14s. 2d.; about the same as most Offices require for the whole of life.

Full Statements of Principles, Tables of Rates, and every information given in the Annual Report, to be had at the

Office in Glasgow—67 ST. VINCENT STREET.

WM. CHURCH, JUN., *Resident Secretary.*



# GEORGE EDWARD & SONS,

DIAMOND MERCHANTS, MANUFACTURING GOLDSMITHS & SILVERSMITHS, CHRONOMETER, WATCH, & CLOCK MAKERS,  
 ROYAL BANK BUILDINGS, AND MANSION-HOUSE BUILDINGS,  
 92 BUCHANAN STREET, 19 POULTRY,  
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Special Designs in SCOTCH PEBBLE and CAIRNGORM JEWELLERY, and Solid SILVER PLATE of every description, suitable for Presentation, &c. &c.  
 G. E. and S. are showing a few Specimens of their Manufactures at the EXHIBITION HALL of the BRITISH ASSOCIATION in KELVINGROVE PARK.  
 They respectfully invite inspection of their stock in SHOW ROOMS at 92 BUCHANAN STREET.

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## SCOTTISH PERMISSIVE BILL AND TEMPERANCE ASSOCIATION.

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The objects of this Association may be clearly ascertained from the following

### DECLARATION OF COMMITTEE.

Fully recognizing the principle of Total Abstinence, carried out into consistent practice, not as a mere matter of expediency, but a duty, based upon Christian morals and sound philosophy, as the only certain remedy for intemperance, we declare that we will not abate our efforts to obtain, by every moral means, its adoption as a rule of life. But, being convinced by long and painful experience that it is next to impossible to secure anything like a general reception and fidelity to the practice of total abstinence from intoxicating liquor in this country, whilst the licensed temptations of the Traffic exist; and, being of opinion that the suppression of the liquor traffic is "*only possible through the united efforts of moral reformers (whether abstainers or not),*" we purpose, in order to obtain this desirable object, to unite the power and influence of the Scottish Abstainers, with all who see the evils of intemperance and are convinced of the necessity for suppressing by law the whole traffic in intoxicating drinks.

Five Agents and Secretary are fully employed. Nearly One thousand meetings are held yearly. An exhaustive electoral canvass of the Scottish Parliamentary burghs is in successful progress, 22 burghs of the 79 having each a local option party unreservedly pledged to support Permissive Bill candidates only. All citizens are eligible for membership. Subscribers paying an Annual Subscription of One Pound receive the *Alliance News* and *Social Reformer* post free; subscribers of 5s. yearly the *Social Reformer* post free. Bankers—Union Bank of Scotland. Every information furnished on application at the Offices, 30 Hope Street, Glasgow.

R. MACKAY, Secretary.

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## THE TYPE WRITER,

A MACHINE TO SUPERSEDE THE PEN FOR WRITING.

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May be seen during Meeting of British Association in Mechanical Department, Kelvin Grove Museum, West End Park.

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Now in use at Admiralty, General Post Office, Bank of England, Board of Trade, Reuter's Telegram Co., "The Times" and "Graphic" Newspaper Offices, and by a large number of Noblemen, Gentlemen, and Mercantile Houses.

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AGENT—

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39 GORDON STREET, GLASGOW.

ESTABLISHED



A.D. 1765.

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OPTICIANS TO HER MAJESTY,  
SPECTACLE MANUFACTURERS,

Mathematical and Philosophical Instrument Makers,

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(NEARLY OPPOSITE ARGYLE ARCADE),

**GLASGOW,**

**Make and Sell**

EYE GLASSES Set in Steel, Tortoise-shell, and Gold Frames.

SPECTACLES in Blued Steel and Gold Frames.

SPECTACLES with Neutral Tinted Glasses or Sun Shades, and for Preserving the Eyes from Dust or Wind.

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POCKET MAGNIFIERS.

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POCKET ANEROID BAROMETERS, with Scale for Measuring the Height of Mountains.

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SURVEYORS' LEVELS.

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TAPE MEASURING LINES.

POCKET SPRING MEASURING LINES.

MAGNETO-ELECTRIC MACHINES.

GALVANIC BATTERIES, for Simultaneous Blasting.

And all other Articles in the Line.



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ESTABLISHED 1835.

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**THE OLD LOVAT WHISKY.**

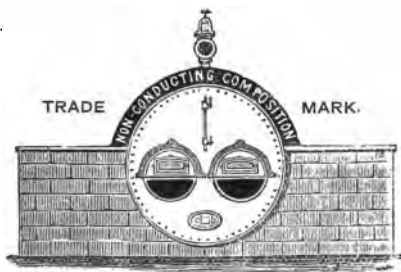
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*18s. per gallon,  
or 40s. per dozen  
(Bottles and Case included).*

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**ARCHIBALD FRASER & SON,  
31, 33, and 37 St. VINCENT PLACE,  
GLASGOW.**

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**FLEMING'S  
NON-CONDUCTING  
COMPOSITION.**

**No. 2698.**

This Cement Coating for Steam Boilers, Pipes, and Cylinders may be seen at nearly all the Works thrown open to Members of the British Association.

**COMPOSITION SECURELY PACKED IN STRONG CASKS FOR EXPORT.**

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*Sole Manufacturer of Fleming's Composition, and Steam Boiler and Pipe Coverer.*

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The  
Queen's  
Laundress  
says this Starch  
is the best  
she ever  
used.

# GLENFIELD.

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ELECTRO-PLATERS AND GILDERS,

Manufacturers of Silver and Electro-plate Spoons, Forks, &c.,

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ELECTRO-SILVER PLATING in all its Branches, and upon all kinds of Metals.

SILVER and PLATED GOODS REPAIRED AS NEW.

ELECTRO-GILDING of JEWELLERY, ORNAMENTS and SILVER GOODS.

PARCEL GILDING and OXIDIZING.

OLD WORK REGILDED AS NEW.

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A LARGE STOCK OF PLATED GOODS ON HAND.

MANUFACTURERS OF THE IMPROVED NEPERIN COFFEE MACHINE.

*Suitable for Hotels and Private Families.*

Price Lists on Application.

**JOHN WALKER,**  
**BISCUIT MANUFACTURER TO**  
**HER MAJESTY,**  
**ROYAL BISCUIT FACTORY,**  
**CLEVELAND STREET,**  
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Calls special attention to his celebrated Biscuits of the Digestive class, which are so highly recommended by Dr. Hassall and other eminent Physicians, viz.

**ROYAL DIGESTIVE,**  
from Entire Wheaten Meal;  
**PATENT GROAT,**  
from Flour of Groats or Oatmeal;  
**SCOTCH OATEN FARLS**  
(OR OATMEAL CAKES);  
and his  
**ENTIRE WHEATEN-OATEN DIGESTIVE BISCUIT.**

This latter Biscuit is made from Entire Wheaten and Oat Meal. It is well worthy of a trial. These and his other famed Biscuits can be had through any respectable Grocer.

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# APOLLINARIS NATURAL MINERAL WATER.

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**A**POLLINARIS.

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43s.; allowed for Bottles on Re-  
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To be had retail at all Clubs, Ho-  
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SOLE AGENTS FOR SCOTLAND AND IRELAND—

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204 STOVES AND RANGES IN COMPETITION

BY ALL THE EMINENT CONSTRUCTORS AND MANUFACTURERS.

The full and severe TRIALS and TESTING OPERATIONS extending over  
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### SMITH & WELLSTOOD,

Of the COLUMBIAN STOVE WORKS,

Occupying the highest position for Efficiency and Economy, and being declared  
by the Records of all the Trials

### FIRST AND BEST,

And theirs, over all other approved apparatus, coming up to and going beyond  
the principal and required standards upon 25 PER CENT. LESS FUEL.

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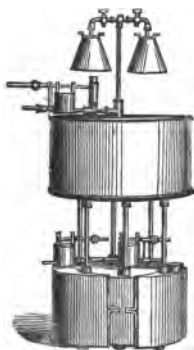
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